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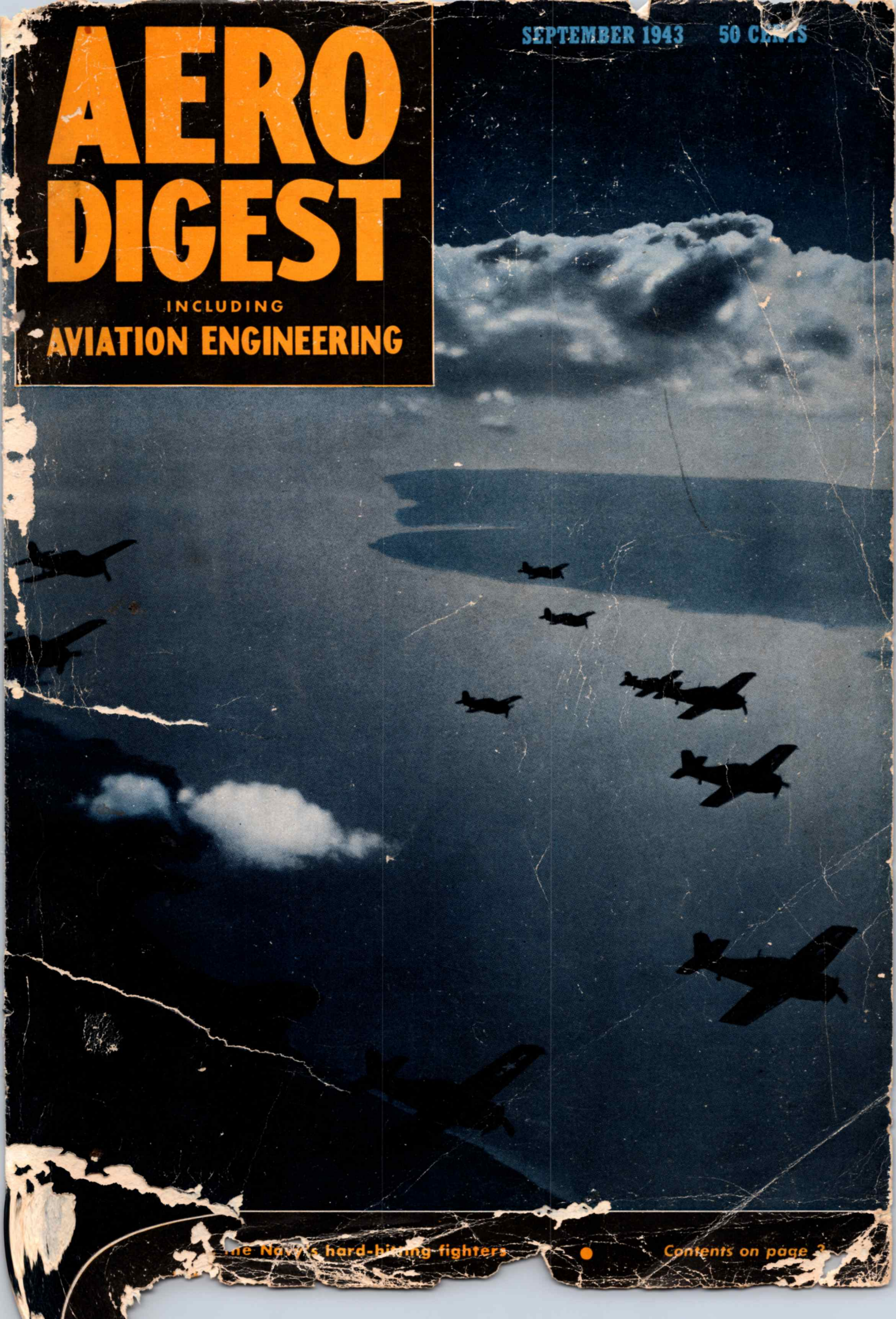

...he Navy's hard-hitting fighters

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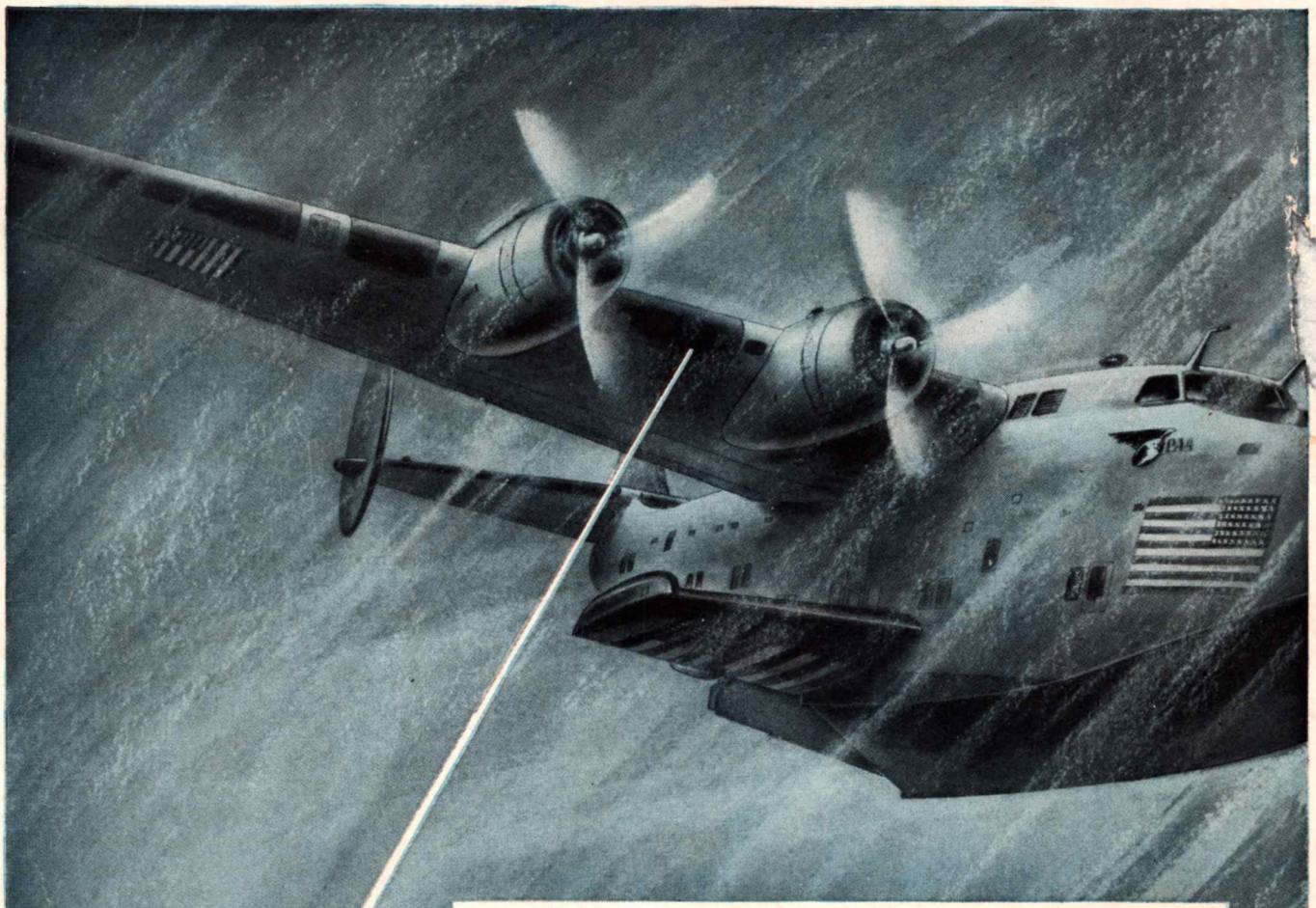

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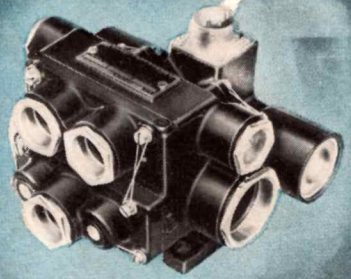

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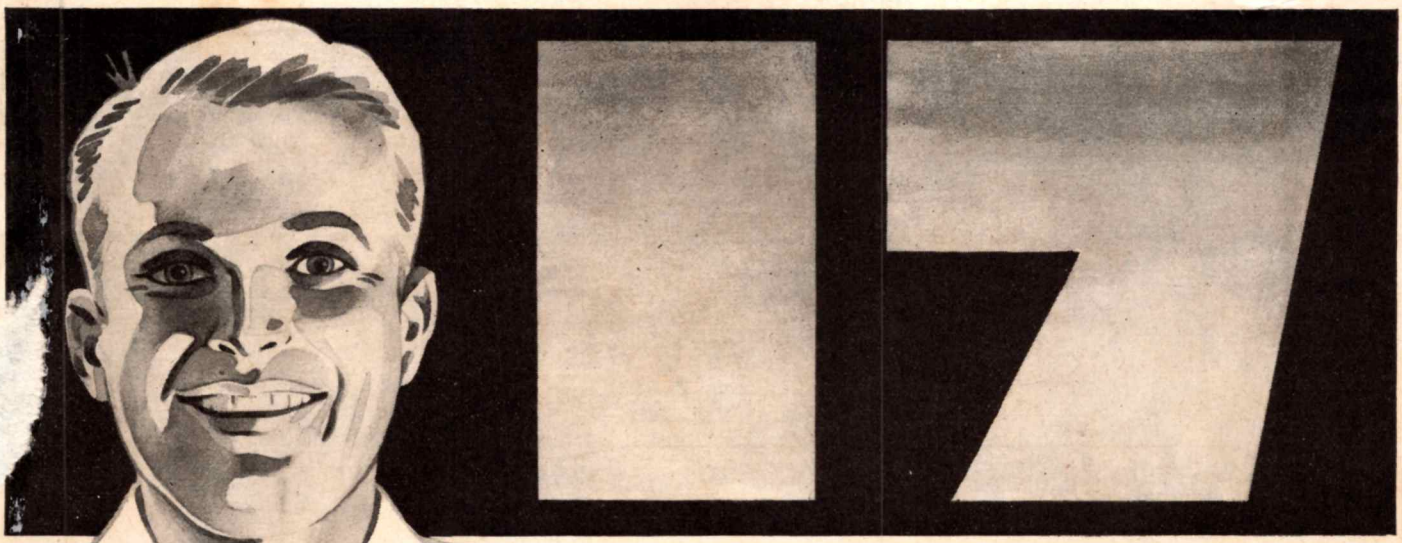

17

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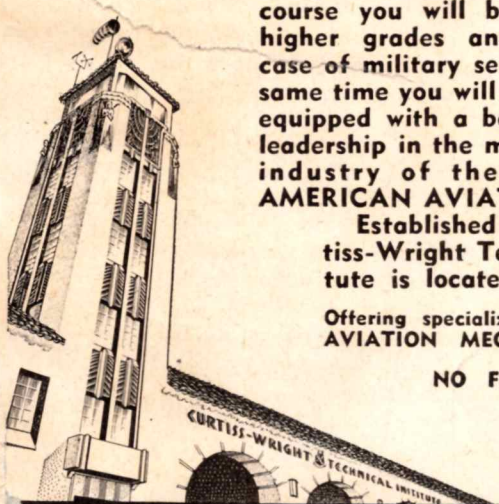

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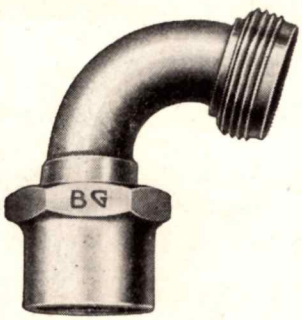
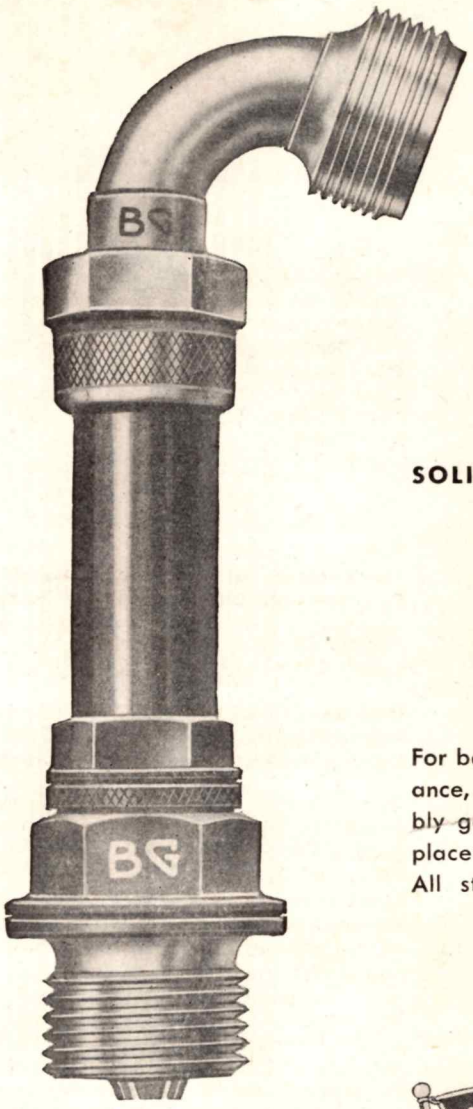
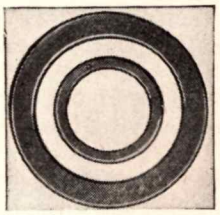


Elbows for use with shielded ignition harness.

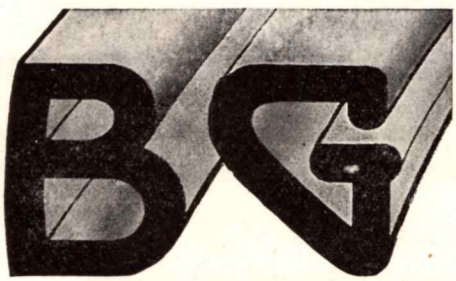
Ignition wire terminal sleeves for use with shielded spark plugs. Ceramic or Formica.

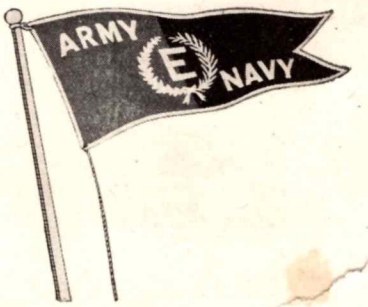


SOLID COPPER GASKETS



For better spark plug performance, new cylinder and assembly gaskets should always replace worn or mutilated gaskets. All standard sizes available.





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VOLUME 43 NUMBER 3

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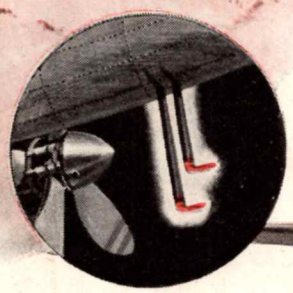

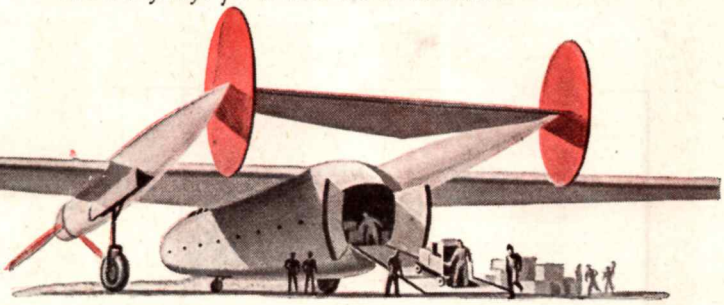

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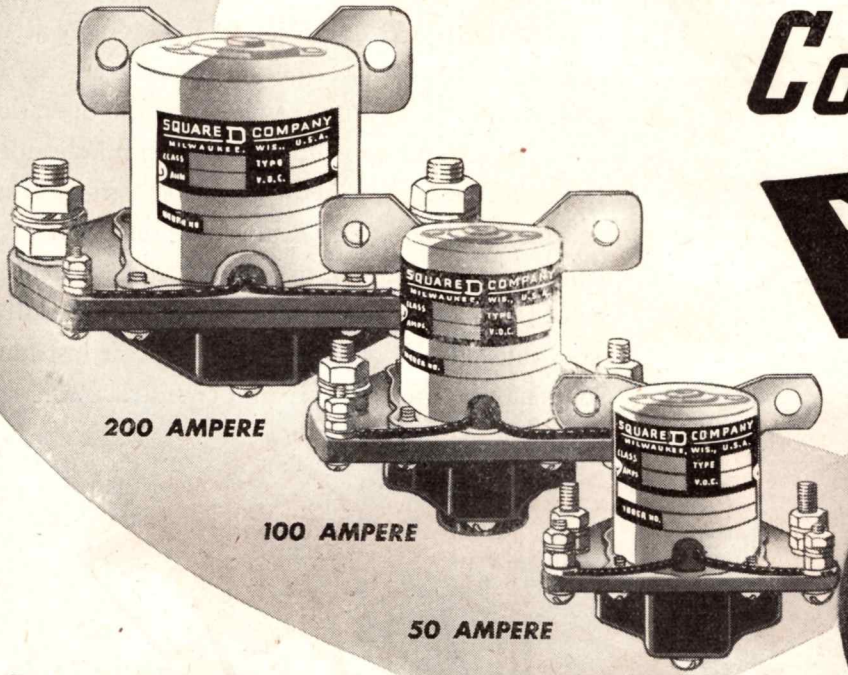

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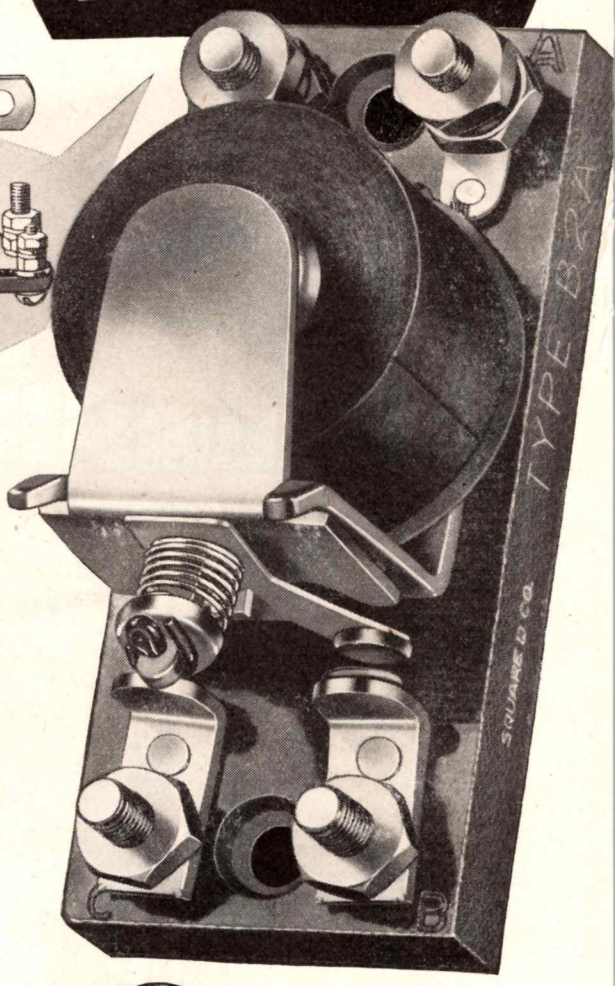

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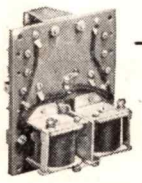
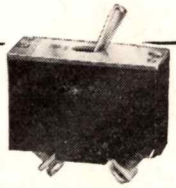


Class 9340, Type 975 INVERTER RELAY



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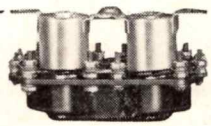

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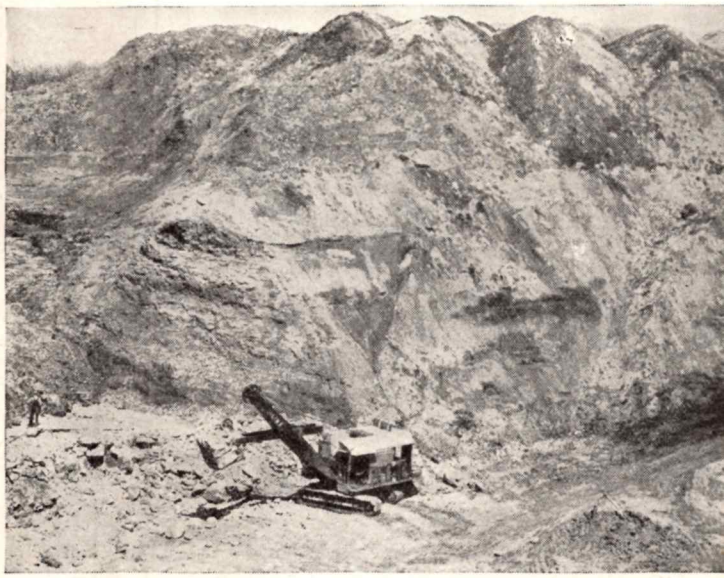

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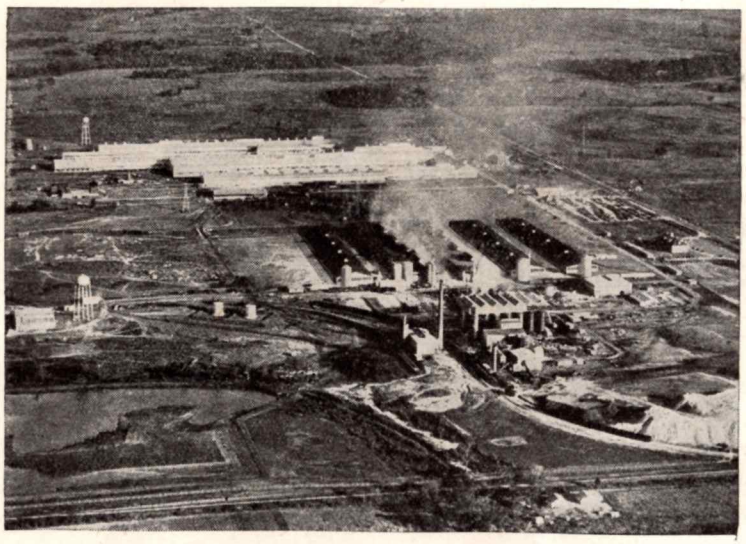

Aerial view of Reynolds plant at Listerhill, Alabama. Here bauxite is refined into alumina; the alumina is reduced into aluminum; and the aluminum is cast, alloyed and fabricated into sheet and rod.

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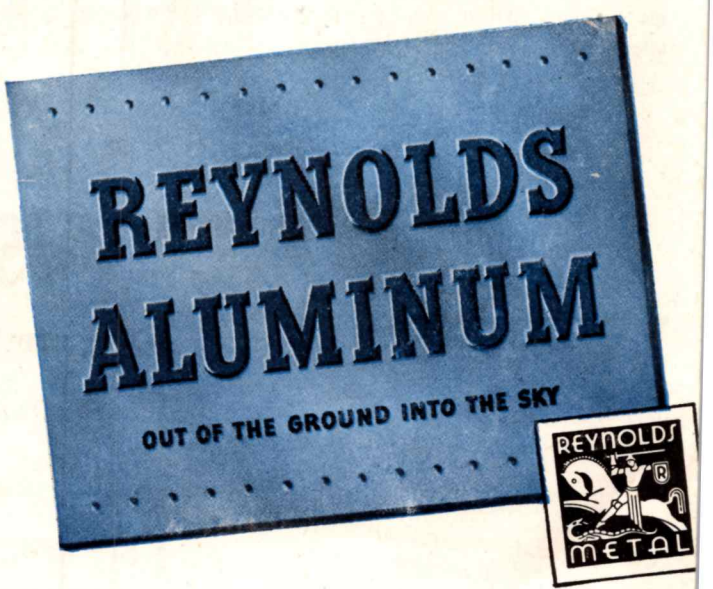
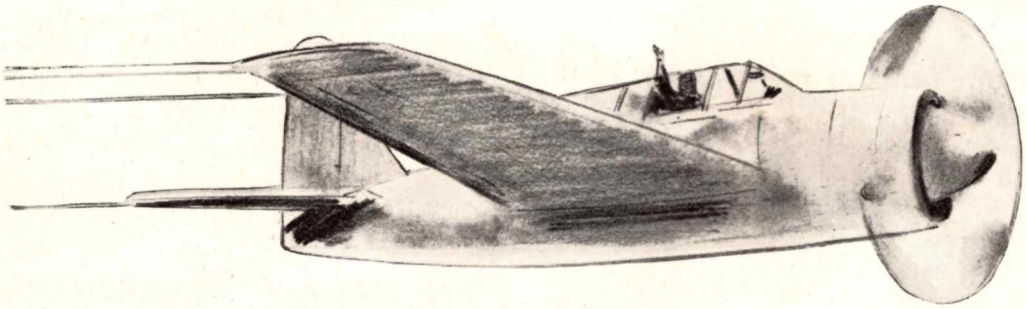
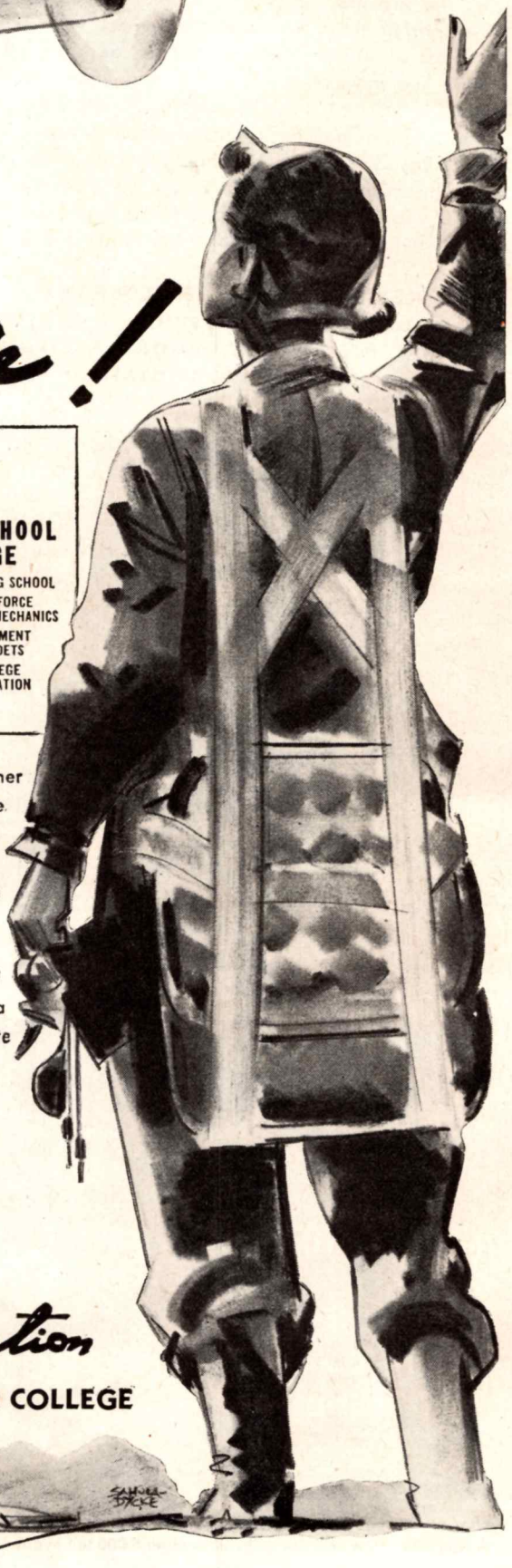
View of the Reynolds 300,000 sq. ft. expansion of the Parts Division in Louisville. New equipment includes giant 5,000 ton hydraulic press.





SHE FIGHTS *by his side!*



HITCH YOUR FUTURE TO THE SKY

DALLAS AVIATION SCHOOL AND AIR COLLEGE

C. A. A. APPROVED GROUND AND FLYING SCHOOL
CONTRACTOR TO U. S. ARMY AIR FORCE FOR TRAINING AVIATION CADETS AND MECHANICS
CONTRACTOR TO BRITISH GOVERNMENT TO TRAIN ROYAL AIR FORCE CADETS
ACCREDITED AS A JUNIOR COLLEGE BY STATE DEPARTMENT OF EDUCATION

THE BLOOD of her pioneer mother still flows through the veins of the American girl. She stands ready to help defend the freedom of the country she loves. In Aviation she is finding one of her greatest fields of usefulness. As pilots in the Ferry Command, as Link Trainer Operators, in radio, in aircraft instrument maintenance, she is proving her mettle. In meteorology, terrestrial and celestial navigation, and in many other essential operations in aeronautics, women are serving in the war. At the same time they are preparing themselves for a future in the world's greatest industry when the peace is won. Dallas Aviation School and Air College offer specialized courses of training in all of these important departments of Aviation. Graduates are immediately qualified to apply for government service and join hundreds of successful women who have already found their places in Aviation. There is a place waiting now for you. Fill in the coupon below and mail it today for complete information—no obligation.

DALLAS *Aviation*

SCHOOL AND AIR COLLEGE

DALLAS AVIATION SCHOOL AND AIR COLLEGE
Major W. F. Long, Dallas Aviation School
Love Field, Dallas, Texas

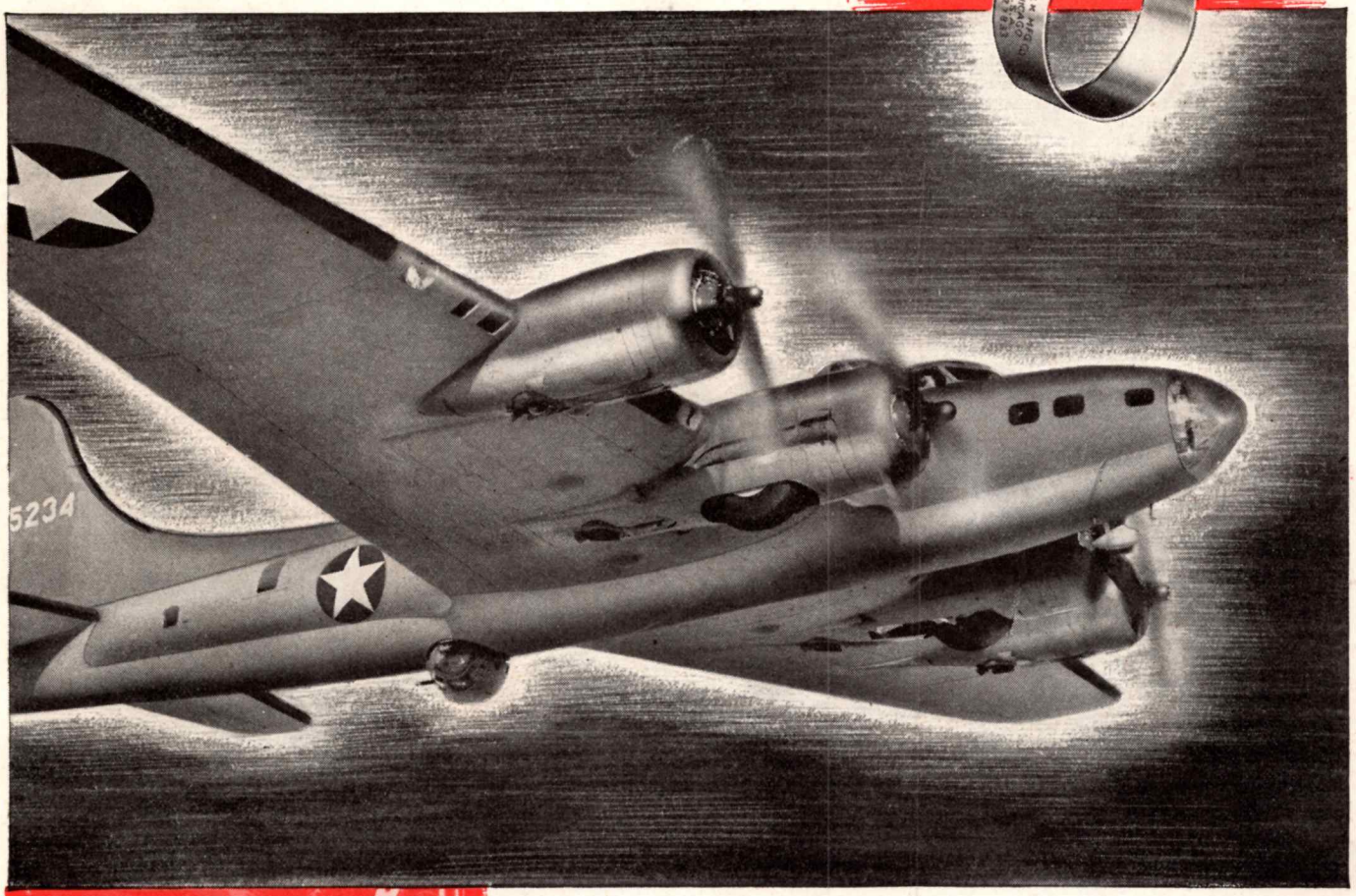
Without obligation, please send your catalog to

Name.....*Age*.....

Address.....

City.....*State*.....

Built to Take It!



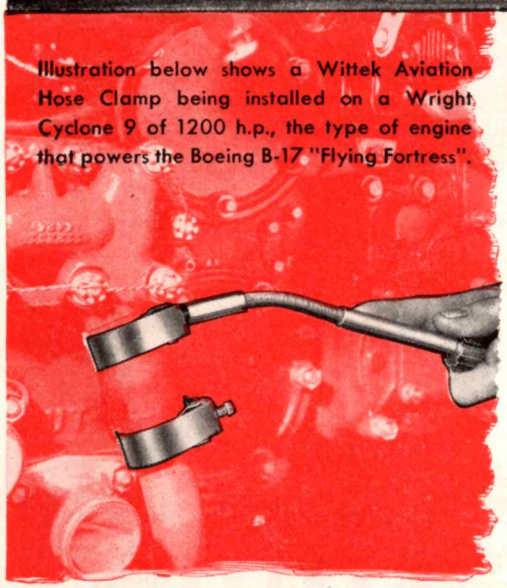


Illustration below shows a Wittek Aviation Hose Clamp being installed on a Wright Cyclone 9 of 1200 h.p., the type of engine that powers the Boeing B-17 "Flying Fortress".

THE BOEING FLYING FORTRESS *is equipped with* WITTEK *Aviation* HOSE CLAMPS

Bombing and slashing at the enemy's nerve centers from Wilhelmshaven to Catania to Rabaul, outfighting his fighters, and returning to bomb and fight again—the Boeing Flying Fortress is equipped with Wittek Aviation Hose Clamps. Today as in the past, Wittek Aviation Hose Clamps, known as the standard of the industry, are being used by the nation's leading military aircraft and engine builders. Wittek Manufacturing Company, 4305-15 West 24th Place, Chicago, Ill.

ARMY E NAVY

BUY MORE WAR BONDS

WITTEK *Aviation* **HOSE CLAMPS**

WALKER-TURNER MACHINE TOOLS

"Ring the bell" at Bell Aircraft..

War production clearly shows the advantages of using machine tools that *fit the job.* Walker-Turner units, using up to 1 H.P., handle many jobs better than heavier equipment. Simplified design enables unskilled workers to "break in" quicker; women operators find them less fatiguing, and their unusually wide range of cutting speeds permits using the optimum speed for the job. Perhaps they could cure some of your production headaches, too.

WALKER-TURNER COMPANY, INC.

4793 BERCKMAN STREET PLAINFIELD, N. J.

Photo Courtesy Bell Aircraft.

Walker-Turner Multi-Spindle 20" Drill Press

Available with or without power feed. Capacity up to 1" in cast iron, ¾" in steel. Standard spindle speeds 260 to 5200 r.p.m. Made also in single spindle, bench and floor models.

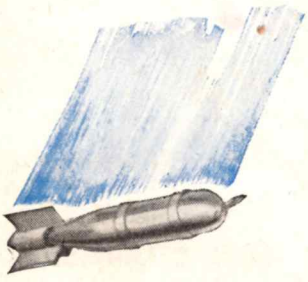
walker-turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

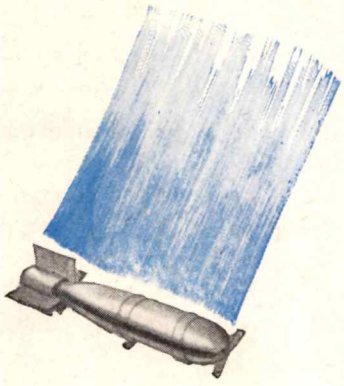
MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

BOMBS AWAY!

You can count on G-E BOMB-DOOR DRIVES to deliver the "eggs"

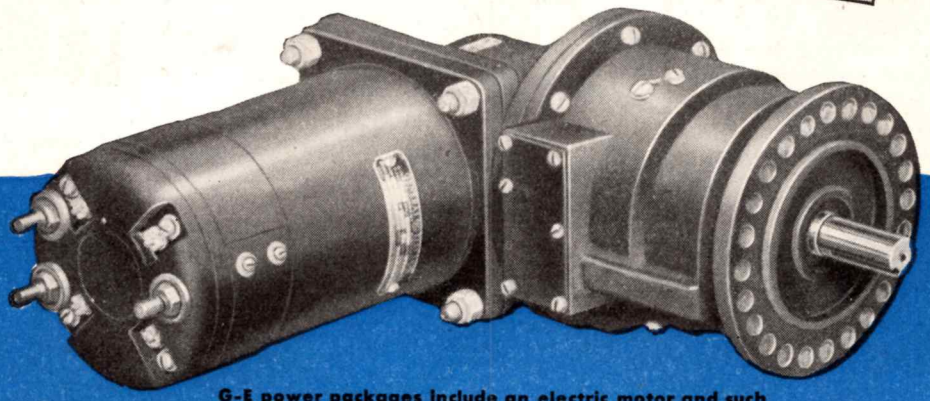




THE PUNCH you need—when you need it—has been built into the G-E bomb-door drive shown below. Careful design, fine materials, and rigid tests have all contributed to making this power package one that will stand up under the toughest combat conditions. For example, one of the many outstanding features of this G-E power package is the winding structure which—because of a superior new insulating technique—is practically indestructible under the severest overloads.

TO DESIGNERS

For complete information about G-E aircraft electric motors, send for our new catalog, GES-3108. *General Electric Co., Schenectady, N. Y.*



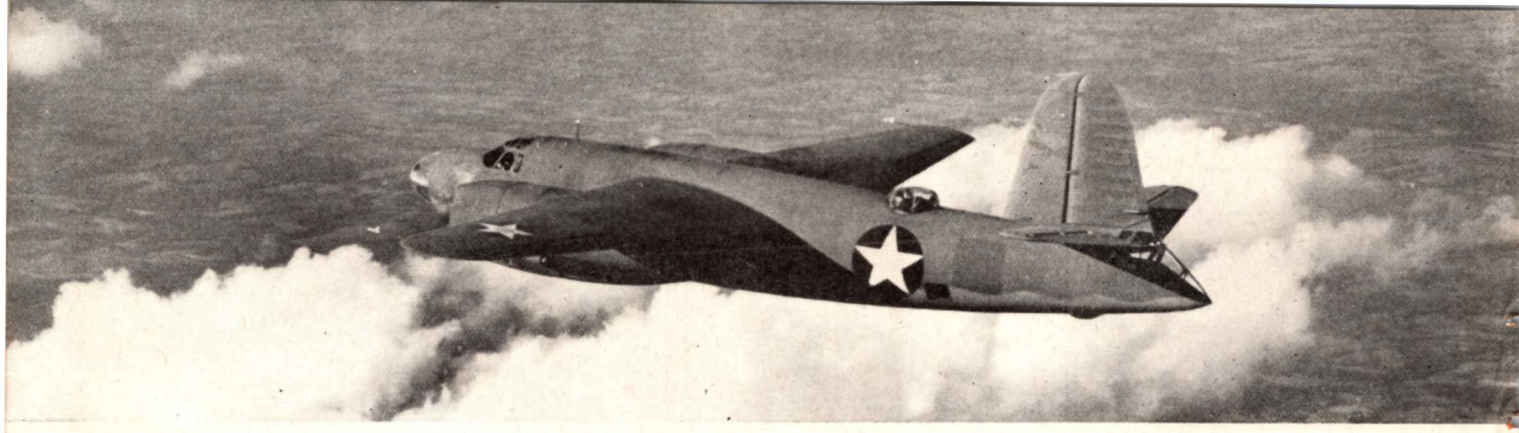
G-E power packages include an electric motor and such accessories as magnetic brake, reduction gears,* and friction clutch. For driving bomb doors, wing flaps, and landing gears.

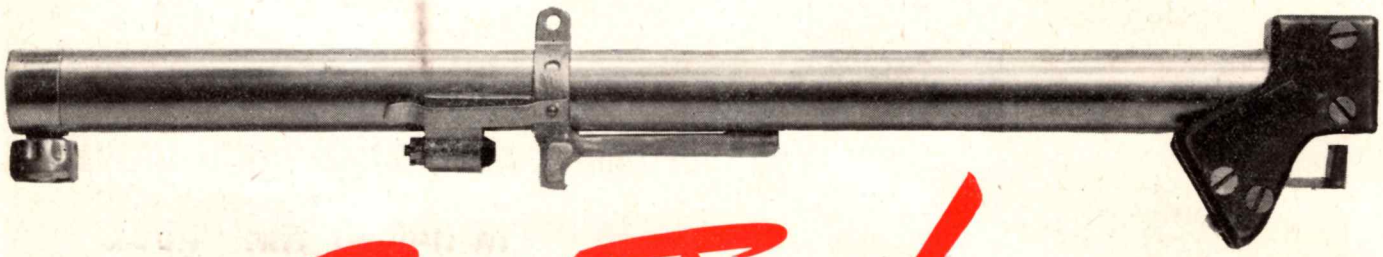
**Reduction gears manufactured by Pacific Gear Works, Los Angeles.*

POWER PACKAGES

GENERAL ELECTRIC

700-68-8200





it's Sure-Fire!

THIS HYDRAULIC MACHINE GUN CHARGER THAT'S HELPING AMERICA SCORE AGAINST THE AXIS

Interstate's mechanical gun charger also has outstanding advantages: It is exceptionally light. It is quickly and easily serviced. It is interchangeable (right or left). In addition, the pulley bracket and guard swivel 360 degrees, making it possible to charge the gun from any angle.

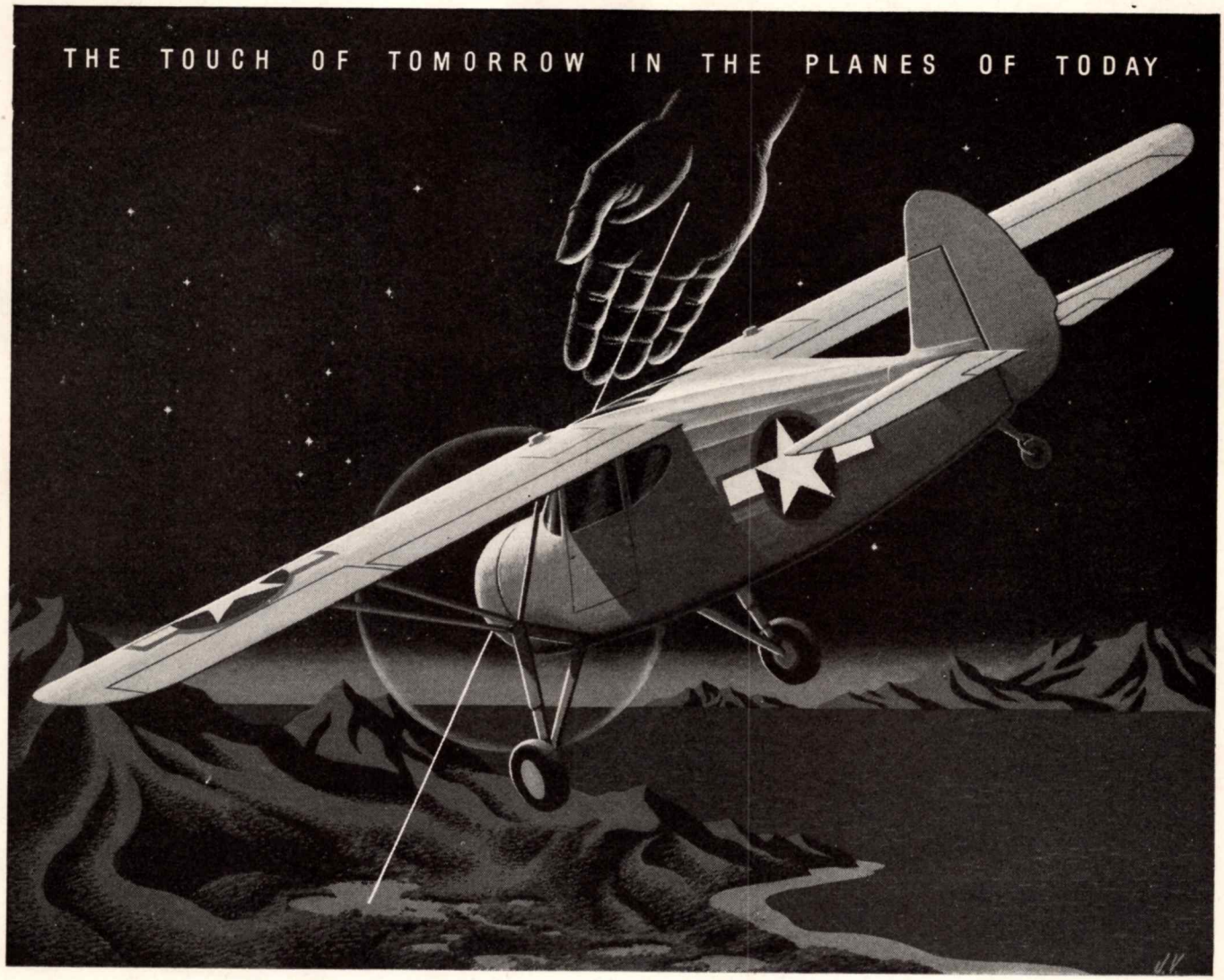
Designed by Interstate engineers to be lighter, more compact, more dependable . . . this hydraulic machine gun charger has proved its performance in the turrets of many a Martin Marauder . . . and in other ships that have helped knock Axis warbirds out of the sky.

This Interstate hydraulic unit has fewer parts; fits into smaller space; can be instantly attached and detached by hand . . . without the use of tools of any kind.

So successful has it proved in actual use on 30 and 50 calibre guns that Interstate has also developed a hydraulic charger for automatic cannon! This large unit, too, reflects the same exacting standards of workmanship that have won national recognition for Interstate Precision Units.

Interstate

AIRCRAFT AND ENGINEERING CORPORATION • EL SEGUNDO, CALIFORNIA



ARGUS—With a Hundred Eyes That Never Sleep

British fighting men know it as the *Argus*—named for a character out of Greek mythology who had "a hundred eyes that never sleep."

To Americans it is the *Forwarder*—the dependable, sturdy little utility-cargo plane.

Officially designated by the U. S. Army as the UC-61A, this little-sung member of the Fairchild airplane family is doing a heroic around-the-clock job on many a fighting front of the United Nations.

Getting precious medical supplies through to where they are needed in a hurry.

Carrying the ammunition to where it is needed most.

Setting down and taking off in tiny patches of clearing, so small that larger planes could not use them.

Shuttling Army personnel between staff headquarters and "where the shooting is."

Acting as the eyes of the Army in remote or inaccessible observation posts.

These and a hundred and one other routine duties well performed have long since earned for the trim little UC-61A the undying affection of men who have depended upon it to get them in and out of tight places.

Those who envision the universal use of airplanes after the war—both commercially and privately—may see in the four-place UC-61A the forerunner of tomorrow's taxi of the air. Another example of Fairchild's "touch of tomorrow in the planes of today."

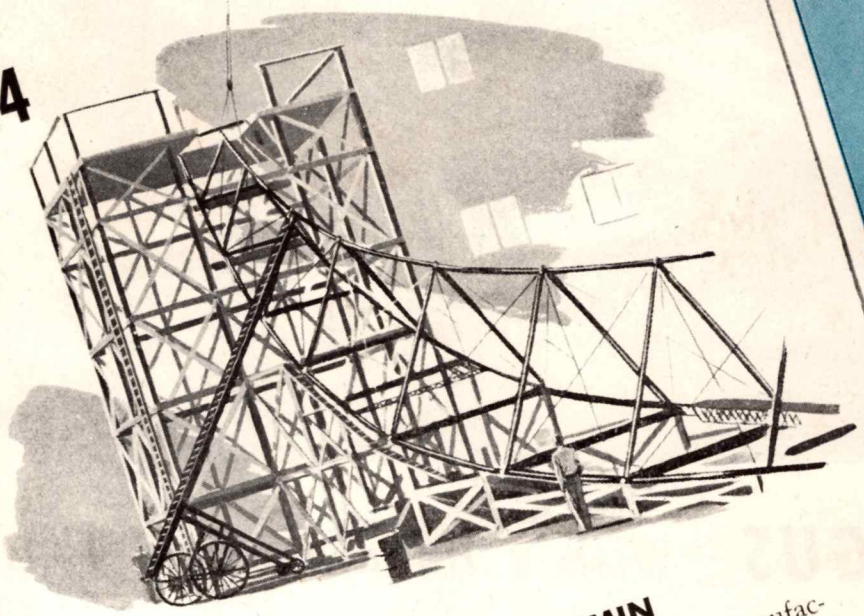
BUY U. S. WAR BONDS AND STAMPS

Fairchild Aircraft

Division of Fairchild Engine & Airplane Corporation, Hagerstown, Maryland.....Burlington, North Carolina

Trail Blazing in the Skies

1924

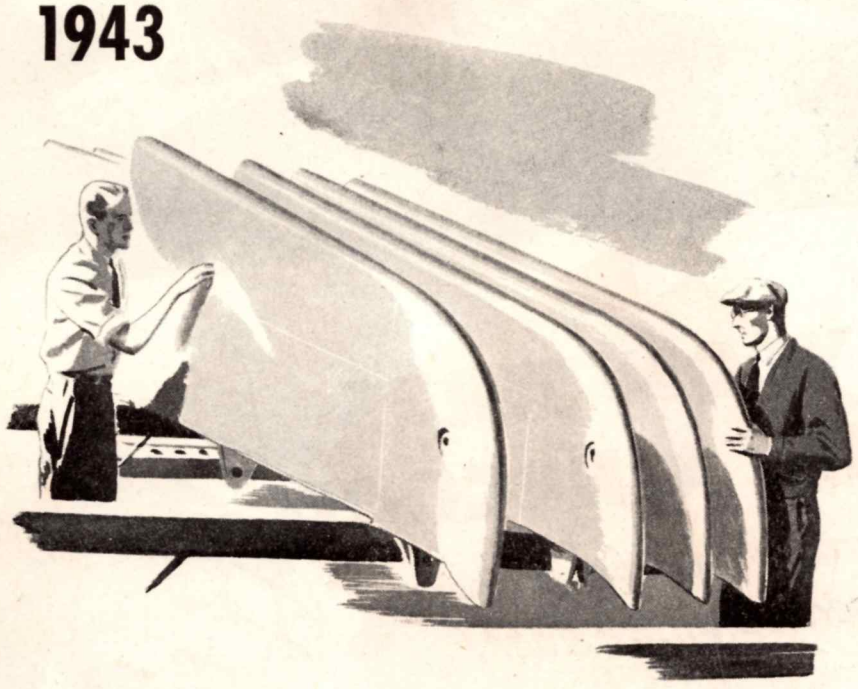


THE FIRST USE OF DURALUMIN IN AIRCRAFT — by a private American manufacturer — was in the keel of the Army semi-rigid airship RS-1, built by Goodyear in 1924. So little was then known of the technique of working duralumin, Goodyear engineers spent a year developing methods of forming, heat-treating and riveting the metal — before beginning work on this keel. Many of these practices first pioneered by Goodyear are now standard in duralumin aircraft construction.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or engineering problem.*
5. *By building complete airplanes and airships.*

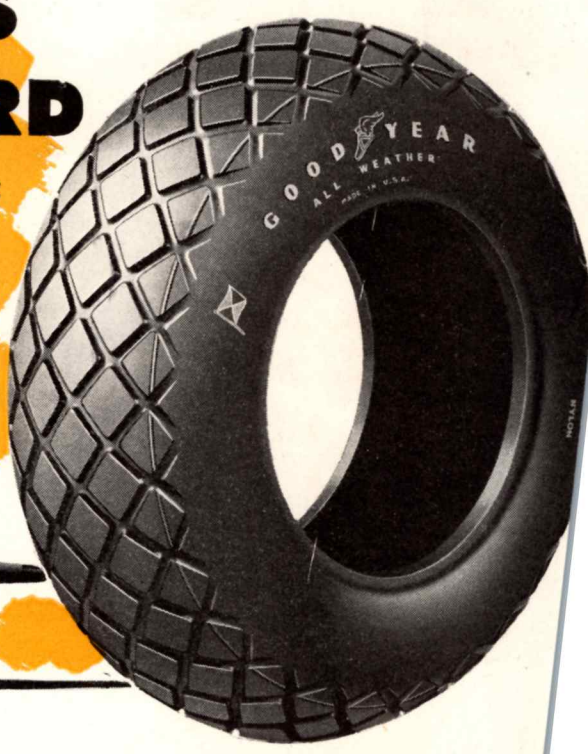
1943

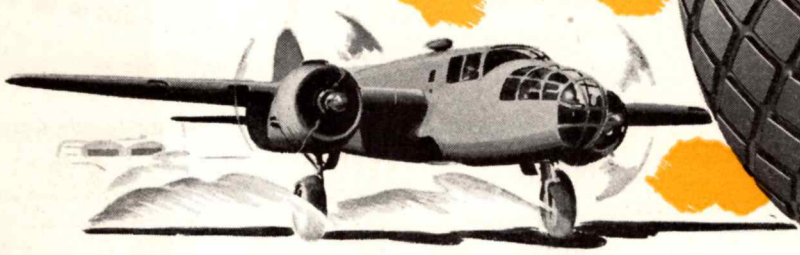


"KNOW-HOW" IN AIRCRAFT METAL WORKING IS THE SECRET of Goodyear's ability to serve airplane manufacturers today in the design (or redesign) and manufacture of all types of parts and subassemblies. Now Goodyear is producing wings, floats and control surfaces for all types of warplanes from hot fighters to the toughest bombers. And in addition Goodyear, along with other companies, is building for the Navy the speedy Vought-designed "Corsair" — the agile fighter that is literally flying circles around the tricky Zero.

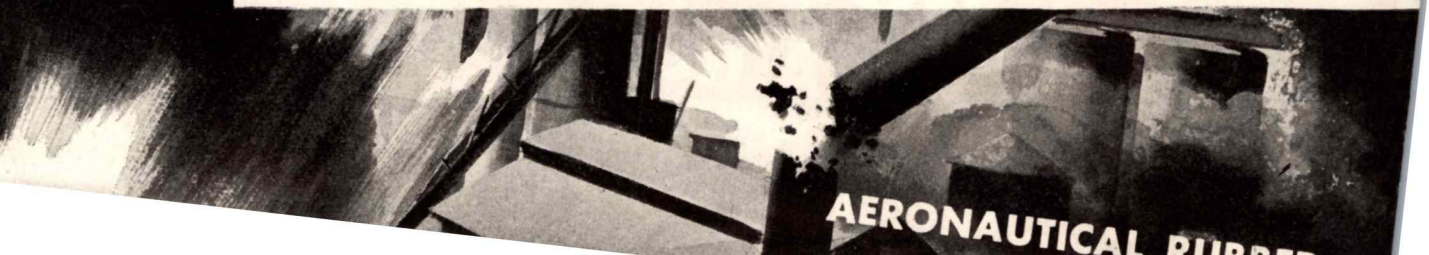
NYLON TIRES WITH A RECORD

—fourteen months' standout service at the front!





NYLON-BODIED airplane tires built by Goodyear have now been on active duty with the Army Air Forces since July 1942. In these fourteen months' service they have more than lived up to every expectation under the hardest kind of operational duty—on both "hot" fighters and heavily loaded bombers. Their greater strength, higher resistance to heat and superior ability to withstand the impact of high-speed landings on rough fields provides further evidence of Goodyear leadership in airplane tire design—and justifies the many months Goodyear spent in developing nylon carcass construction. Goodyear nylon-bodied tires are being supplied in many sizes today for both main and tail wheels.



FOR AMERICAN AIRCRAFT

HYDRAULIC BRAKE HOSE

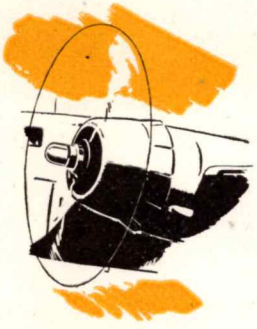
with a big safety plus

Goodyear Hydraulic Brake Hose is built to withstand *many times* the pressure required for normal braking service. This high safety factor insures dependable performance in the severest emergencies.

MOLDED RUBBER GOODS

for any service

Goodyear's large, modern molded rubber goods plant is equipped to produce molded aircraft fittings and accessories built to your specifications — or we will design to meet your problem.

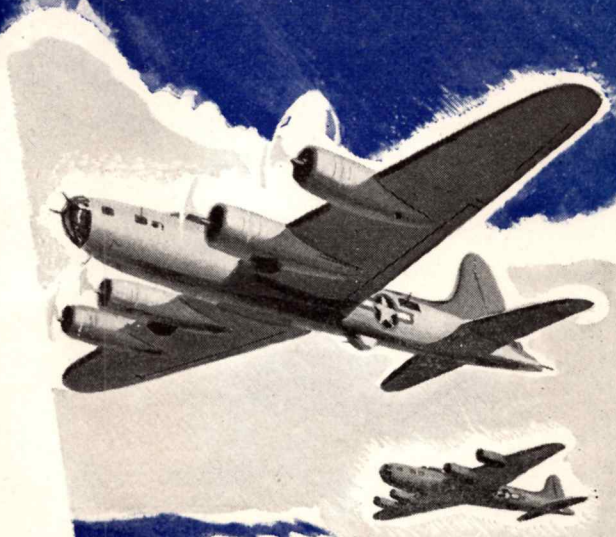


VIBRATION DAMPENERS

to gentle 2000 "horses"

Goodyear engine mounts hold down vibration below operational ranges, improve flight characteristics and instrument operation, reduce strain on crews. Made in approved types for many sizes of engines.

For Victory
BUY MORE BONDS



Since the days of the Wright Brothers

AVIATION RUBBER HEADQUARTERS

With a background of more than 30 years in developing tires, tubes, wheels, brakes and other aircraft accessories, Goodyear engineers are ready to serve you in working out any problem involving the use of rubber — natural or synthetic. Address: Goodyear, Aeronautics Dept., Akron 16, Ohio, or Los Angeles 54, California.

GOODYEAR

GOODYEAR

THE GREATEST NAME IN RUBBER

GOODS . . . TIRES · TUBES · WHEELS · BRAKES

Leadership, in war or peace, places a responsibility upon any organization. Perfect Circle is maintaining its leadership in the aviation industry as it has for so many years in the automotive industry. Today Perfect Circle is manufacturing millions of aircraft piston rings designed to meet the most exacting requirements of those who make the world's finest aircraft engines.

The Perfect Circle Companies

Hagerstown, Indiana • Richmond, Indiana • Newcastle, Indiana • Tipton, Indiana • Toronto, Ontario, Canada

Perfect Circle has once again written
a new page in piston ring history.

9 REASONS Why You Should Use ROCKBESTOS FIREWALL AVIATION WIRE

REG. U. S. PAT. OFF.

1 The conductor (a) is perfectly and permanently centered in helically applied insulation that will not flow or migrate under high temperatures, a point of essential importance in small diameter wires carrying the minimum of insulation.

2 The thin synthetic tape primary dielectric (b) has unusually high dielectric and mechanical strength and moisture resistance. It helps keep insulation thickness and weight down, withstands high ambients, and frigid cold without becoming brittle; bending, flexing and vibration without fracturing, and also keeps conductor clean and makes stripping easy.

3 The asbestos firewall (c), applied between the outer braid (d) and primary dielectric (b), provides maximum degree of heat and flame resistance that can be built into an aviation wire. Maximum operating temperature is 125° C. but the firewall maintains coverage up to melting point of copper.

4 The firewall provides the essential safety factor of flame resistance. The felted asbestos is flameproof and the heat, flame and moisture resisting compounds with which it is impregnated are also flame resistant.

5 Constructed of inert, heatproof, fireproof asbestos, the firewall withstands deterioration that normally comes with aging and the attack of destructive agents leave it unchanged. It will not dry out, burn, rot, flow, swell, or bloom when exposed to heat, flame, moisture, oil, grease, gasoline or cleaning fluids.

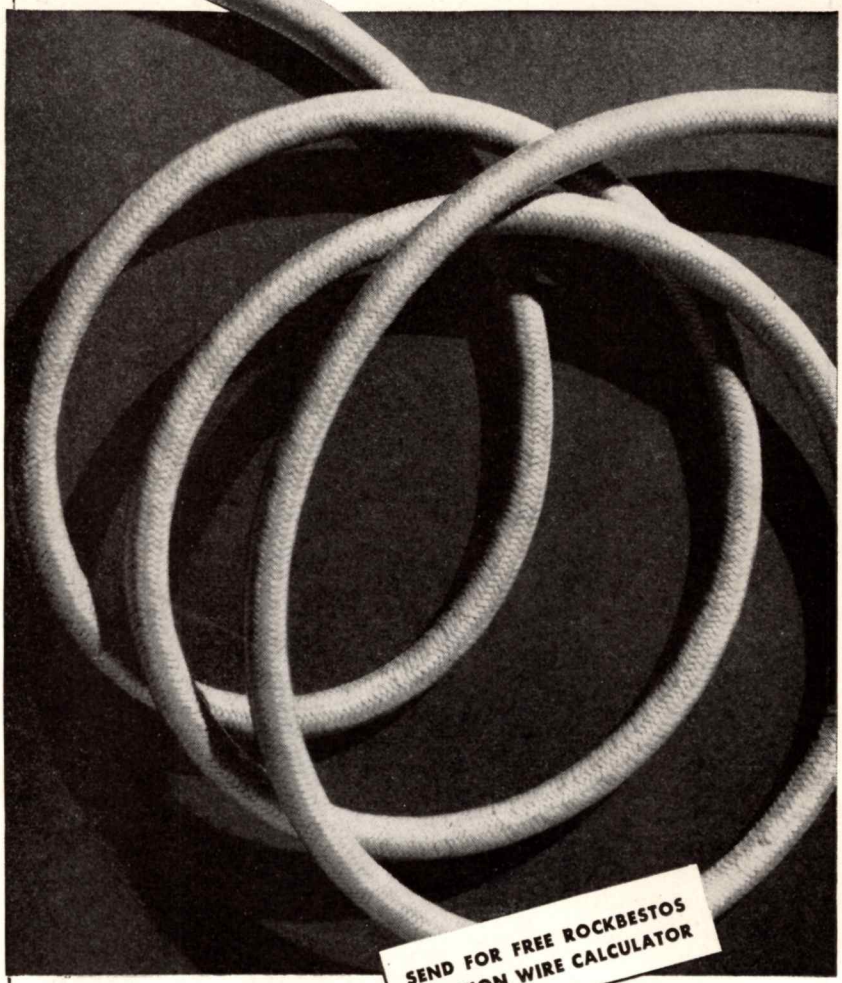
6 The firewall is a resilient, flexible insulation that won't dry out under high temperatures or become brittle in frigid cold down to minus 50° C.

7 Because the firewall is resilient, it "gives" like a cushion and provides mechanical protection to the primary dielectric and braid by minimizing the possibility of injury caused by abrasion or vibration during installation or operation.

8 The covering is a plain braid (d) of glass, cotton, or rayon finished with flame-resistant cellulose acetate lacquer to a hard smooth, moisture repellent finish that never becomes gummy or tacky and resists heat, flame, cold, oil, grease and gasoline.

9 Rockbestos Firewall Aviation Wire is designed to obtain the maximum factor of safety and dielectric stability and at the same time maintain the essential small diameters and minimum weights.

122 different wires and cables have been developed for severe operating conditions by Rockbestos



SEND FOR FREE ROCKBESTOS AVIATION WIRE CALCULATOR

Rockbestos Firewall Aviation Wire is designed especially for aircraft. It won't ignite, burn or carry flame under copper-melting arcs. Its heatproof and flame-resistant characteristics not only guard against wire-fires but also prevent communication of flame to adjacent circuits. It is approved under Specification AN-J-C-48 and is manufactured in conformance to Spec. AN-J-C-48a (awaiting approval) in sizes No. 22 to 4/0 AWG with glass, cotton or rayon braids. For sample and literature write nearest branch office or:

Rockbestos Products Corporation, P. O. Box 1102, New Haven, Conn.

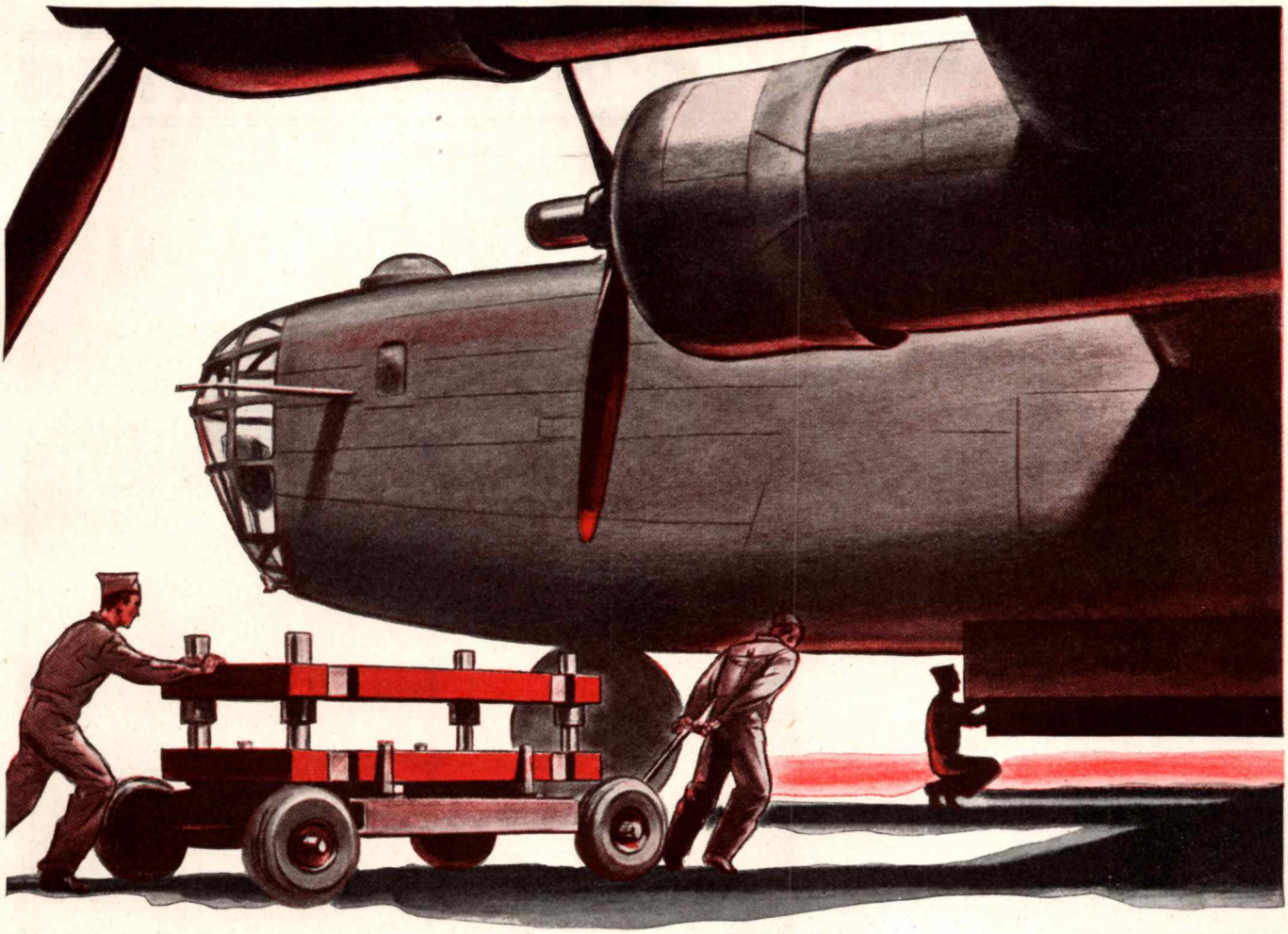
★ *FOR VICTORY INVEST IN U. S. WAR BONDS* ★

PERMANENTLY INSULATED · ROCKBESTOS · WIRES AND CABLES

ROCKBESTOS
Firewall Aviation Wire

REG. U. S. PAT. OFF.

NEW YORK, BUFFALO, CLEVELAND, CHICAGO, PITTSBURGH, ST. LOUIS, LOS ANGELES, SAN FRANCISCO, SEATTLE, PORTLAND, ORE.



They don't load Die Sets in BOMB BAYS

Die sets are work-a-day products that stay at home, holding and guiding the dies that stamp out and form plane parts by the millions. We can safely and proudly say that Danly Die Sets have speeded America's air program.

Danly facilities and service have been steadily increased since 1940. One of the major objectives was to be ready for the mass production of planes—that was sure to come—that came—planes that are blasting the way to winning the war.

If you need die sets in any phase of your production call Danly.

DANLY MACHINE SPECIALTIES, INC.
2100 South 52nd Avenue • Chicago, Illinois

Call Danly:

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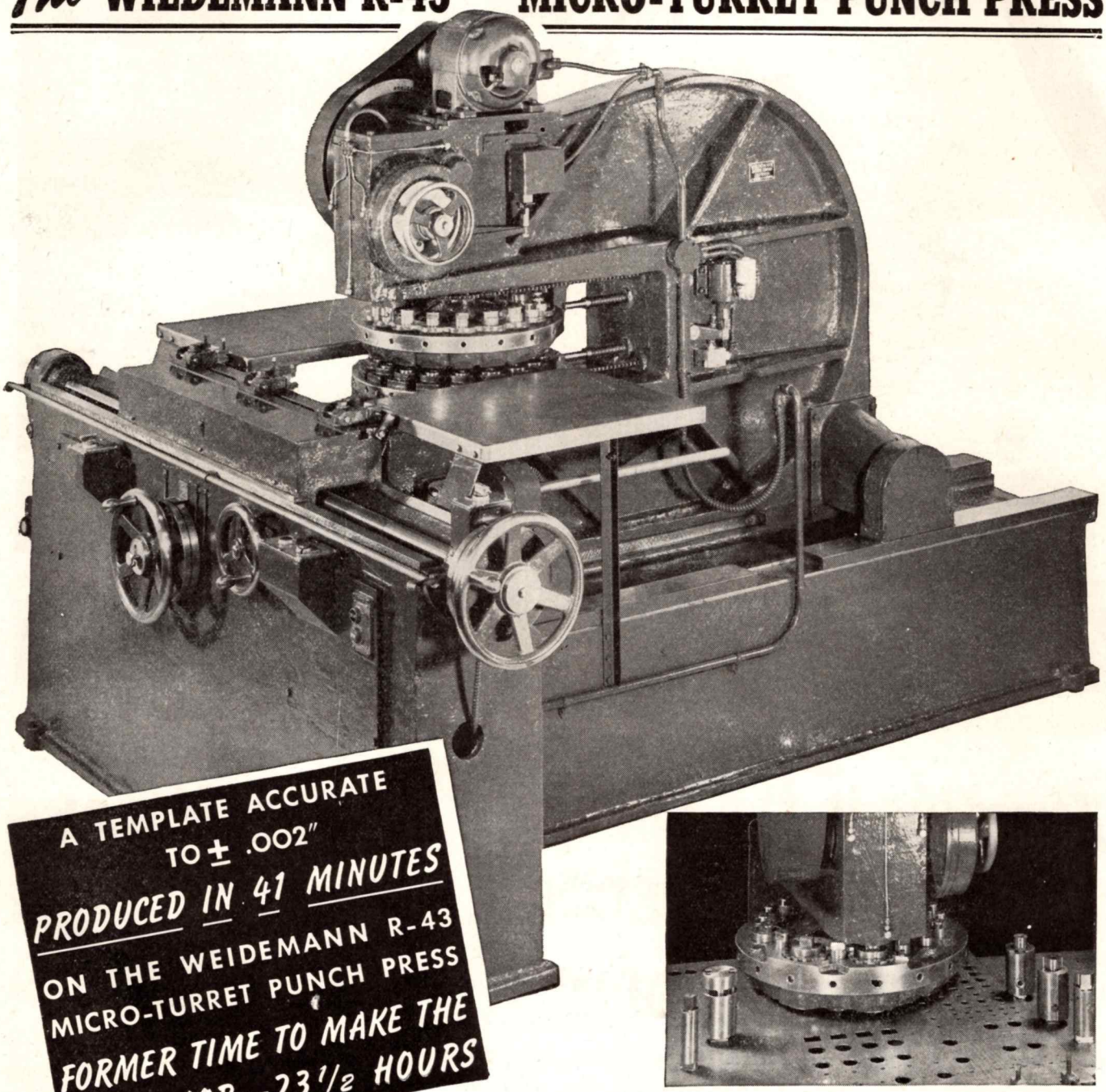
DANLY DIE SETS

Welded Steel Fabrication

The WIEDEMANN R-43 MICRO-TURRET PUNCH PRESS



A TEMPLATE ACCURATE TO ± .002"

PRODUCED IN 41 MINUTES

ON THE WEIDEMANN R-43 MICRO-TURRET PUNCH PRESS

FORMER TIME TO MAKE THE SAME JOB—23½ HOURS

The Wiedemann R-43 has revolutionized the production of accurate templates. No layout is required and there is no die set-up time or costly preparation. The Micro-Turret Press pays almost unbelievable dividends in labor saving and speed on accurate piercing of templates.

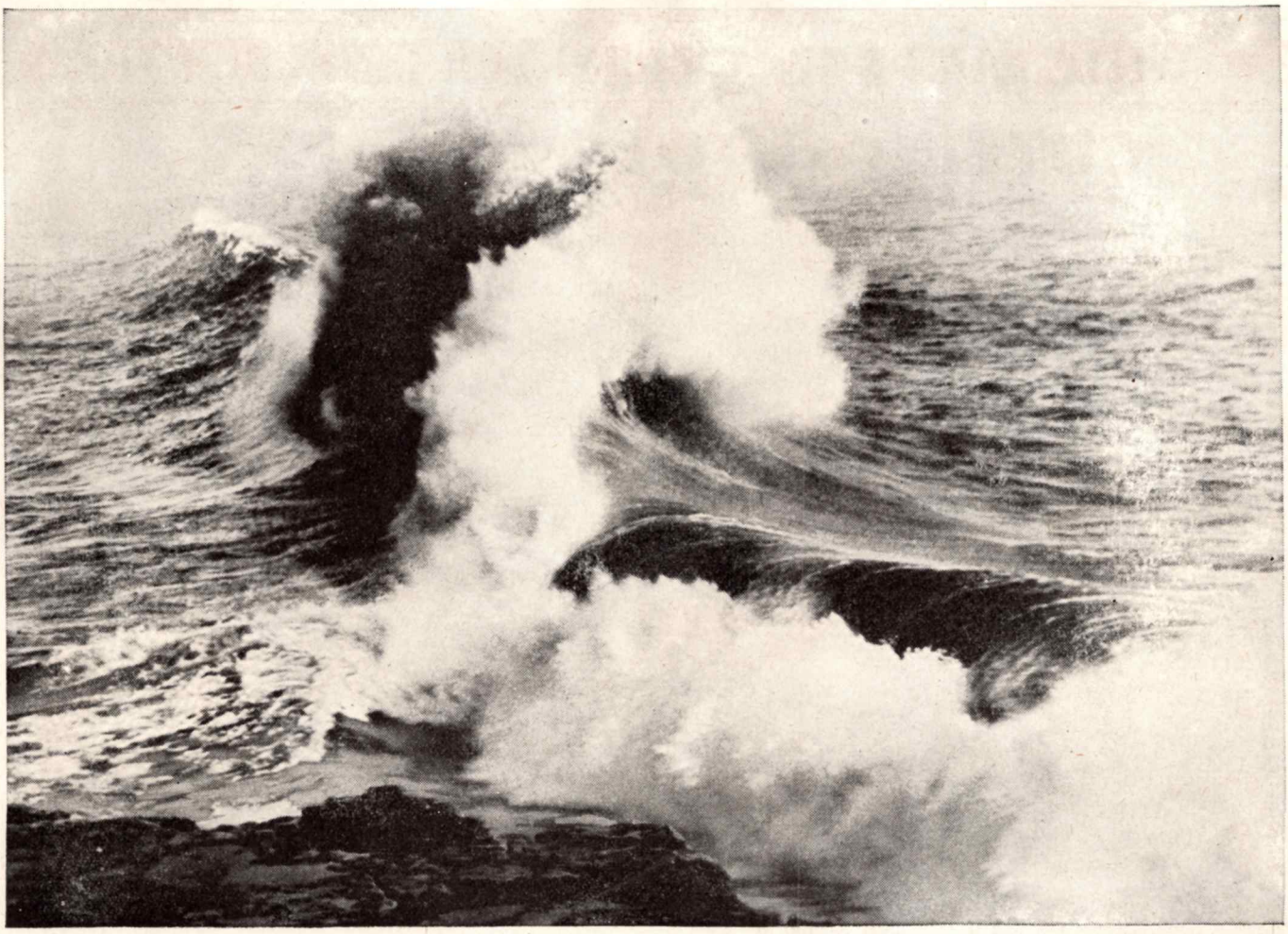
Get the facts. Write today for a newly published bulletin on the Wiedemann R-43 Micro-Turret Punch Press. All details of operation and construction are thoroughly discussed. A copy will be sent for the asking.

HERE ARE THE ACTUAL FACTS:

- Mild Steel 1/8" x 26" x 34½".
- 91 holes pierced over entire material area.
- 16 different hole sizes from .156" to .687" diameter (rounds, squares, rectangles, clusters).
- Accuracy of hole location ±.002"
- Total Elapsed Time on Micro-Turret Punch Press—41 Minutes.
- Total Elapsed Time on Jig borer: 23½ hours.
- Job produced and times supplied by leading radio equipment manufacturer.

WIEDEMANN MACHINE COMPANY
1830 SEDGLEY AVENUE, PHILADELPHIA 32, PENNA.

WIEDEMANN TURRET PUNCH PRESSES & GAUGE TABLES



This is the reason they called the tube KLYSTRON*

Does it seem far-fetched to you?

Can there be any possible similarity between an ocean wave and an ultra-high frequency tube?

As a matter of fact, there's a very definite similarity.

A breaking wave is the best way we know to picture what happens to electrons in the KLYSTRON tube invented by the Varian brothers—Russell and Sigurd—and Dr. William W. Hansen.

Inside this tube, the inventors were able to direct a stream of electrons which concentrated their power and released it much as waves do when they mount into crests and crash on the shore.

That's why the tube is called KLYSTRON. The name comes from a Greek word that denotes the breaking of waves on a beach.

Initial research on the KLYSTRON was done in California at Stanford University. The Sperry Gyroscope Company was quick to see the tube's possibilities. So they helped the inventors carry on further development of the KLYSTRON as a valuable tool of war and aeronautics.

When the tube got beyond the early experimental stages, the Varian brothers and Dr. Hansen joined Sperry's staff of inventors, engineers, and research men.

With the close co-operation of the Army and Navy, the development and perfection of the KLYSTRON continued, and is still continuing.

Applications of the KLYSTRON include the generation, amplification, and reception of ultra-high frequency waves. Naturally, they are being devoted exclusively to war uses at present.

When the war is won, Sperry research will explore the fascinating field of KLYSTRONICS** in relation to the comfort and security of a world at peace.

SPERRY

GYROSCOPE COMPANY, INC.

BROOKLYN, N. Y.

Division of the Sperry Corporation

*KLYSTRON is a registered trademark of the Sperry Gyroscope Company—Registration No. 371650.

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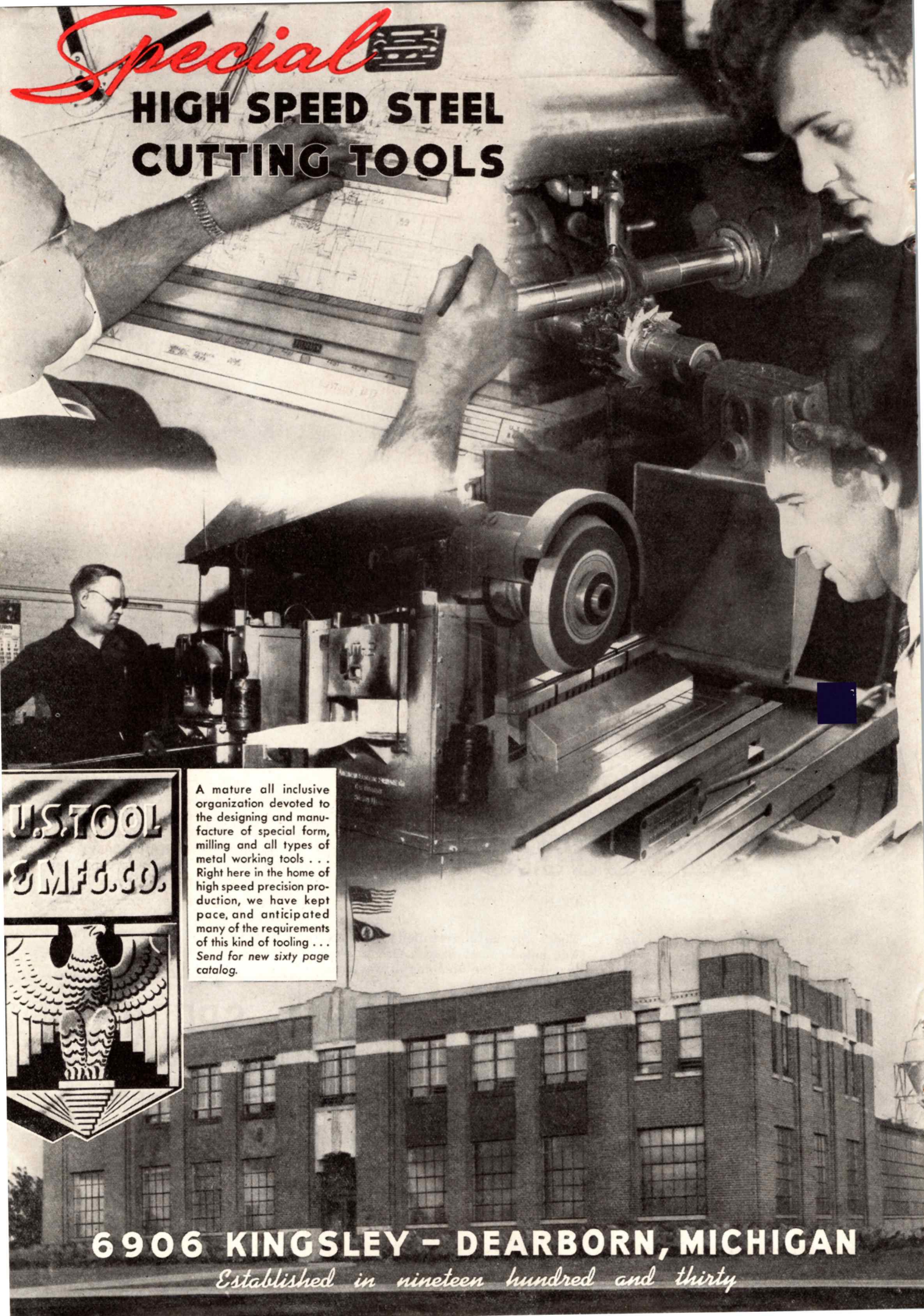
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A mature all inclusive organization devoted to the designing and manufacture of special form, milling and all types of metal working tools . . . Right here in the home of high speed precision production, we have kept pace, and anticipated many of the requirements of this kind of tooling . . . Send for new sixty page catalog.
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Established in nineteen hundred and thirty

GIVE 'EM THE GUN!

With the kind of tool that reaches the *"hard to reach"* rivet. Give 'em the gun with a YORK ELECTRIC...

ROUND THE CORNER RIVETER

Adapter

Fits any standard Pneumatic Riveter

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OTHER AIRCRAFT PRODUCTION TOOLS

that save labor and material

PRESSURE PAD DIMPLING TOOLS

Developed by the America's leading aircraft tool design engineers and have successfully met Army and Navy tests.

SCOTCH TAPE PRINTER

A new portable Tape Printer that produces any new code mark or series of letters and digits instantly. It permits each aircraft plant to print its own without costly delays.

MICRO-SWITCH

An automatic dimpler adapter that speeds production and avoids spoilage.

HOT STAMP WIRE PRINTER

Wire printed by this has been immersed in gasoline and oil for one-hundred hours without damage. It has withstood the Army and Navy's severest tests.

YORK ELECTRIC AND MACHINE CO.

AIRCRAFT TOOL DIVISION

1241 W. King St.—YORK, PA.

BOMBS AWAY!

Says the Grimes Indicator Light

Bomber pilots must know how many bombs they have dispatched and how many they have left for other targets. Grimes indicator lights instantly provide such information.

Tiny lights on the instrument panel tell the pilot when each bomb leaves the rack . . . no chance for miscount . . . no guessing whether the bomb is "on the way."

This is but one of the many ways in which Grimes lights are serving our flying forces. More than 120 different types of Grimes-designed lights are standard equipment on American aircraft on all fighting fronts.

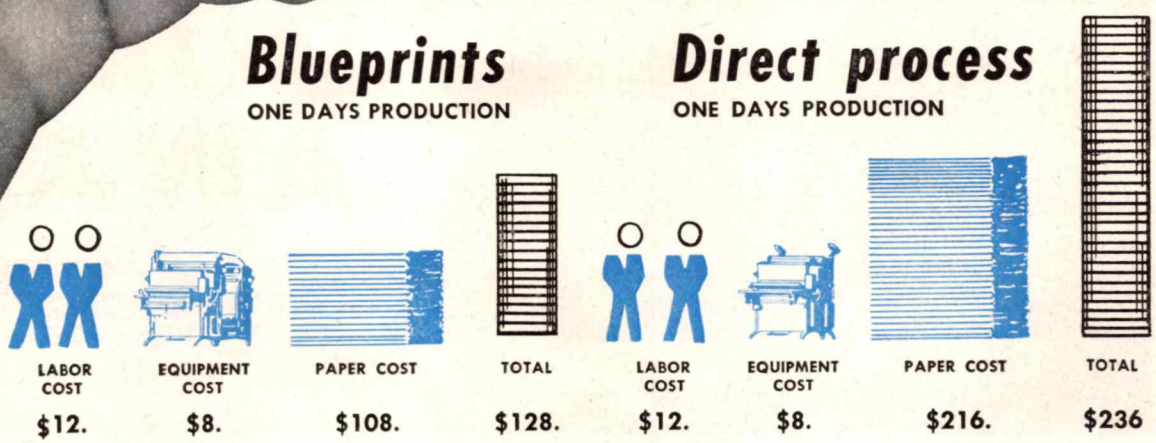
Grimes Manufacturing Company, Urbana, Ohio

If it's Aircraft Lighting...

GRIMES

Designs and Makes it!

½c can grow into THOUSANDS OF DOLLARS



Blueprints save thousands in large production

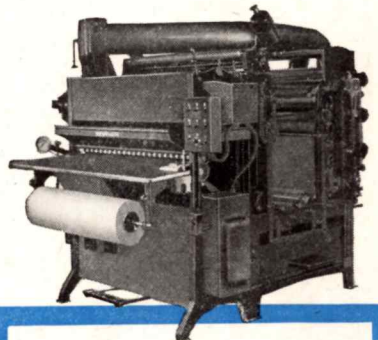
In a typical day's run, due to the difference in paper costs, the total cost of Direct Process Prints would be 85% greater than Blueprints. Assuming that prints 36″ wide are being made on continuous yardage (the most efficient method for large production of either BLUEPRINTS or Direct Process Prints) at a speed of 15 lineal feet per minute (21,600 sq. ft. per 8-hr. day or 2700 sq. ft. per hr.) with labor, amortization, power, etc., equal—you can save $108.00 per day!

HERE is one instance where Blueprints save $108.00 over Direct Process Prints on one 8-hour day—in paper cost alone!

For small and medium production requirements Direct Process Prints do have some advantages . . . but for large production *it's always BLUEPRINTS* . . . and from a cost standpoint, whether production requirements are medium or large, *it's always BLUEPRINTS.*

Based on paper of the same weight, quantity and rag content BLUEPRINT paper costs about ***one-half cent*** per square foot compared to ***one cent*** per square foot for Direct Process Paper. In a year's production this "fractional" difference can mount into thousands of dollars.

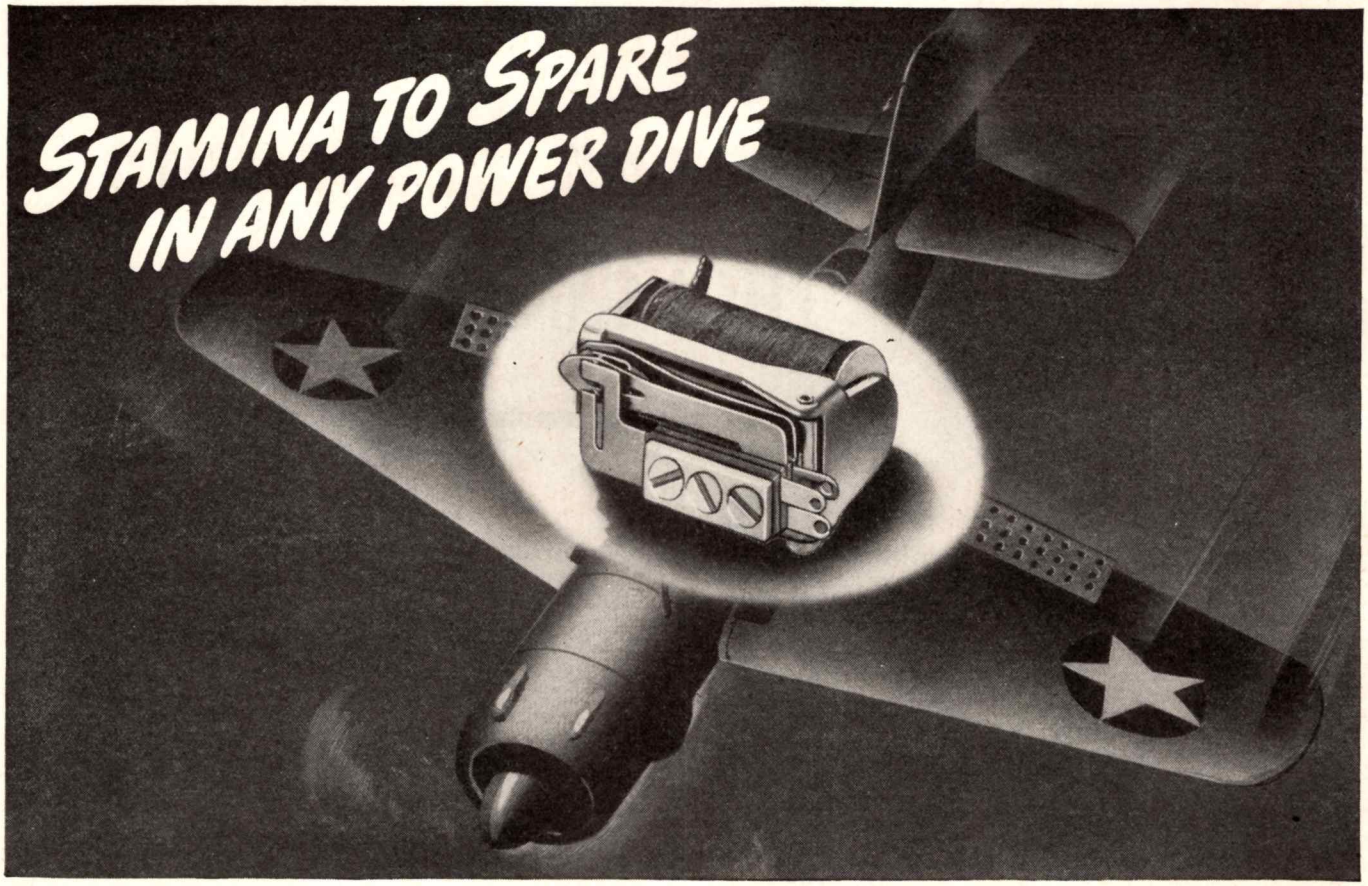
For more information, send for the NEW "Paragon-Revolute HANDBOOK OF PRINT-MAKING AND PROCESSING." Address Dept. 9A.



FIGHT YOUR PRODUCTION BATTLES WITH BLUEPRINTS

BLUEPRINT paper costs only half as much as other types of reproduction papers—about ½c per sq. ft.
BLUEPRINTS give you good clear working copies from VanDyke negatives.
BLUEPRINTS are not easily sabotaged . . . alterations are immediately apparent.
BLUEPRINTS are authoritative . . . a direct order from the Engineering Department . . . Men in the shop are accustomed to them.
BLUEPRINTS stand up better in shop use . . . will take more handling . . . don't show soiling. Accidental marks can't lead to misinterpretation.
BLUEPRINTS are easier to read.
BLUEPRINTS improve with age . . . there are no chemicals left in the paper to turn yellow or destroy the paper.

PARAGON-REVOLUTE CORPORATION
77 SOUTH AVENUE • ROCHESTER 4, N. Y.



FLYING'S toughest test — the power dive — is "duck soup" for the new Automatic Electric Class "S" Relays. Their sturdy construction is proof against the most terrific vibration that modern flying can set up.

Class "S" Relays have been designed with aircraft requirements especially in mind. Small in size, light in weight, but packed with power, they offer a combination of features never before found on any relay, large or small. For example:

1.—Vibration resistance is designed into Class "S" Relays — not "added on." They withstand with a large margin of safety, the most rigorous operating tests required by the Signal Corps and the Air Forces.

2.—A unique spring design provides high contact pressure within small space limits.

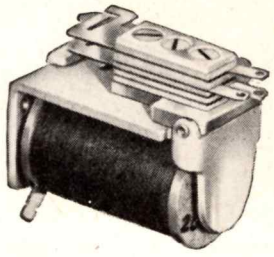
3.—Additional safeguards are provided by independent, self-cleaning twin contacts.

4.—A new type of pin-pivoted armature with full-length bearing, provides exceptionally long life under severe service conditions.

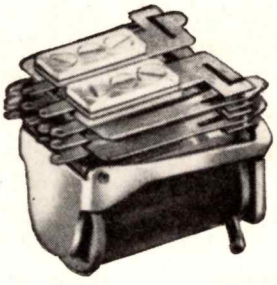
Why not get the whole story about Class "S" Relays? Write for engineering data giving full specifications of these and other Automatic Electric Control apparatus.

AUTOMATIC ELECTRIC SALES CORPORATION
1033 West Van Buren Street, Chicago, Ill.
In Canada: Automatic Electric (Canada) Limited, Toronto

Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC ELECTRIC**



Class "S" Relay — Single Arm

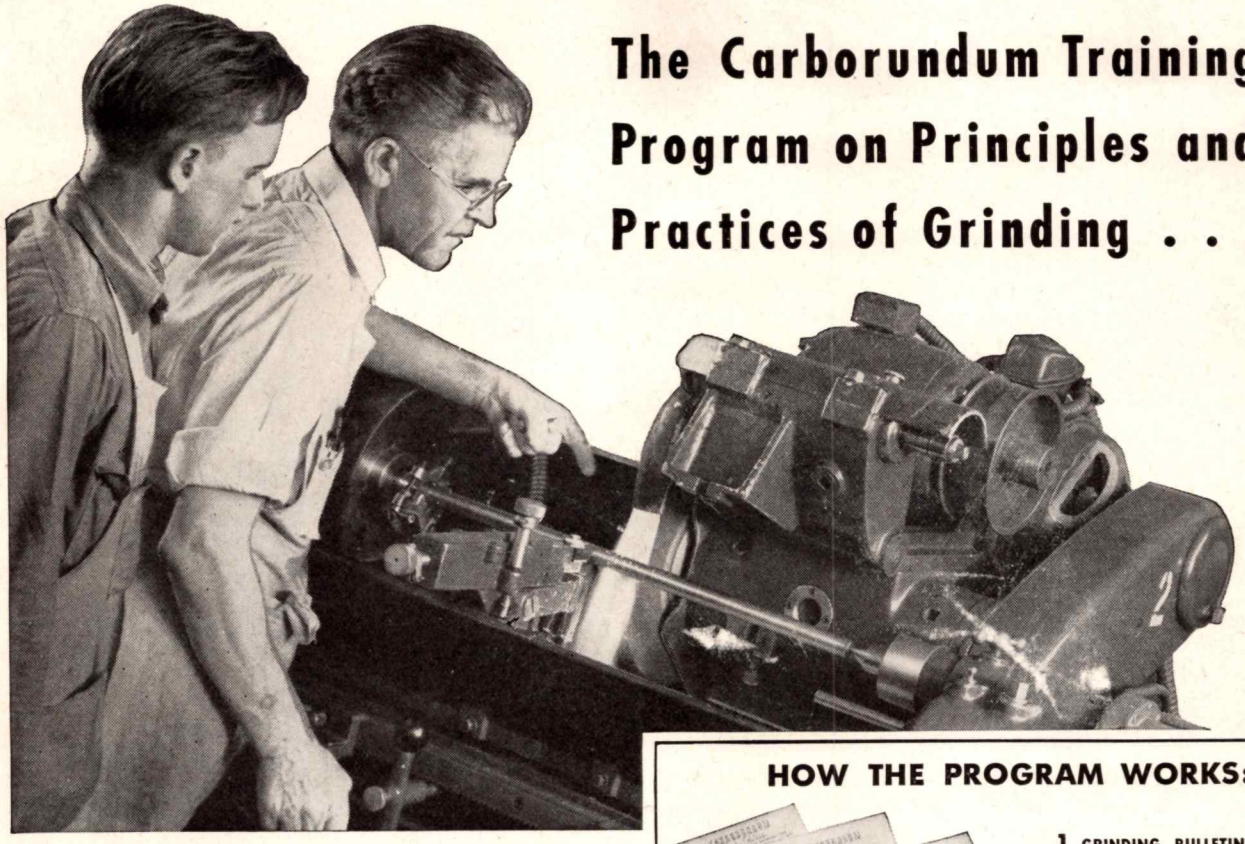


Class "S" Relay — Double Arm

Class "S" Relays are available with a wide variety of coil and contact combinations and operate and release speeds. The single arm relay has a capacity of six contact springs—the double arm, twelve springs. Springs may be provided in any combination and arrangement of "break," "make," or "break-make" assemblies.

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED

FREE! FOR TRAINEES IN INDUSTRY!



The Carborundum Training Program on Principles and Practices of Grinding . . .

THE problem of training green workers for precision war work is one of the biggest jobs industry has ever tackled.

Here is our contribution to its solution—a streamlined course in the principles and practices of grinding, offered to trainees in *your* Plant!

The purpose of the Carborundum Training Program is to explain in simple, non-technical terms the fundamentals of grinding and thereby help make better grinder hands of trainees, apprentices and students.

This course is designed for both classroom and small group instruction. Since its introduction, it has been widely adopted throughout industry. We hope it may help you, as it is helping others, to simplify the training of new grinder hands and to speed them on their way to higher production and greater accuracy.

THE CARBORUNDUM COMPANY
REG. U. S. PAT. OFF.

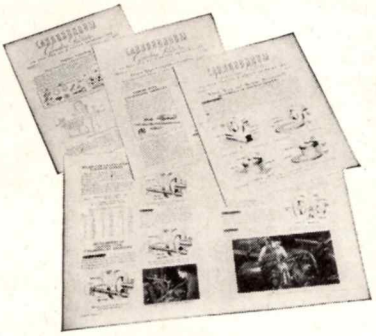
Niagara Falls, N.Y.

MANUFACTURERS OF GRINDING WHEELS, COATED ABRASIVES, SUPER REFRACTORIES, HEATING ELEMENTS

Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company)

HOW THE PROGRAM WORKS:



1. GRINDING BULLETINS. A set of 25 four-page bulletins for each trainee, offering a concise, non-technical discussion of grinding wheels and their functions. Sample of the contents: "The Abrasive Tools of Industry", "Wheel Stresses", "Wheel Balancing", "Cylindrical Grinding", "Grinding Errors", "Safety".

2. BOUND VOLUMES. A limited number of bound Grinding Bulletins are available for instruction as well as for placement in your classroom or technical library for reference purposes.

Educational Service Department
THE CARBORUNDUM COMPANY, NIAGARA FALLS, N.Y.

We would appreciate your sending us added information on the Carborundum Training Program.

☐ We have regular apprentice training courses. Average enrollment _____ students.
(Number)

☐ With _____ instructors assigned.
(Number)

☐ With adequate classroom facilities

Name.....

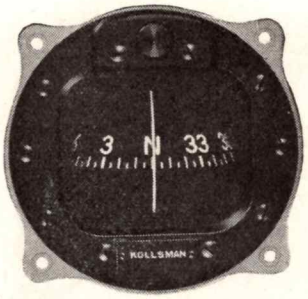
Title.....

Company.....

City and State.....

CORSAIR FIGHTERS
Brothers in Arms
BUCCANEER AND BERMUDA DIVE BOMBERS
SINCE
Brewster
1810

THE DIFFERENCE BETWEEN THIS



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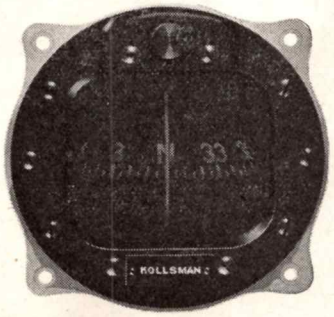

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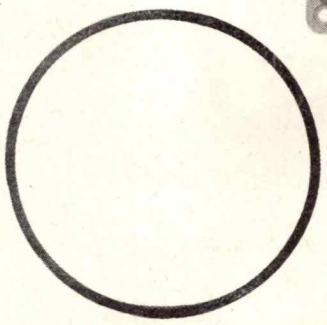


In the split-second decisions of modern aerial warfare, a pilot often doesn't have time for a second look at his instrument board. So manufacturers of aircraft instruments take every precaution to assure clear, true vision of numbers and graduations.

One of these precautions is selection of exactly the right gasket to seal the glass. Take a compass gasket, for example. It must not contain extractables which could cause cloudiness or discoloration of the liquid in the bowl and thus make markings obscure. It must resist deterioration by the liquid. And, to seal this fluid in and keep dust out, it has to retain its resilience throughout wide temperature variations.

Instrument gaskets in general must be compressible, to avoid breaking the glass during assembly. They should not cold-flow over the glass and thus detract from the appearance of the instrument. In many cases they must be sulphur-free, so as not to tarnish silvered elements.

To meet such requirements, the manufacturer of the aircraft compass shown above selected one of the more than fifty Armstrong Compositions developed to solve specific sealing problems. Gaskets of this material are giving trouble-free service not only in the compass but also in the sensitive altimeter made by the same company.

Armstrong Compositions are being used in a variety of other aircraft instruments. Sealing materials, however, are only one of several kinds of products Armstrong makes for aircraft. See the list below . . . then write us for complete information about those materials that interest you. Armstrong Cork Company, Industrial Division, 1509 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG CORK COMPANY

Aircraft (A) Materials

- Gaskets, packings, seals, piston cups, bushings, and valve seats—for gauges, meters, fuel lines, hydraulic systems, and other aircraft equipment
- Composition roll goods, with or without fabric back, plain or adhesive-coated—used as glazing strip, binding tape, cushion pads, anti-skid flooring, and gaskets
- Tank strap cushions
- Sealing materials for equipment handling aromatic fuel
- Felts for vibration-damping and soundproofing
- Wingwalk materials and Airoflor
- Carburetor floats and other fabricated cork specialties

This advertisement is one of a series which will appear in national magazines and newspapers this year as Consolidated's contribution toward a clearer public understanding of "aviation geography."

This Soviet worker in Yakutsk, Siberia, lives only 28 hours flying time from the Washington, D. C. airport

It's 37 hours' flying time from Kansas City to this Chinese student's home, outside Chungking.

The office of this newspaper publisher in Calcutta, India, is 41 hours' flying time from Times Square, N. Y.

This Alaskan Eskimo lives near Fairbanks—13 hours' flying time from the Chicago airport.

A 23-hour flight from Boston will put you in the office of this wholesale coffee dealer in Sao Paulo, Brazil.

The Pacific atoll where this Fiji Islander lives is only 34 hours' flying time from Denver.

No man on earth lives more than 60 hours from your local airport...

"A LOT OF THINGS are different in India than they are back home in Altoona," wrote a 19-year old sergeant in the U. S. Air Forces to his mother in Pennsylvania.

Never before in his life had this boy travelled beyond Pittsburgh — until he flew to India in a Liberator bomber.

To him — and hundreds of thousands of home-town American boys like him — India was a place "off there somewhere." He'd seen it in the newsreels and travelogue films. In his geography book he'd learned something about India's crops and minerals and untold riches, and the funny way the people dressed.

The world as it really is

Now his letters from overseas — telling how people talk and work and live in a strange land he never dreamed he'd see — *are penetrating into the lives and thinking of his family and friends in the town where he grew up.*

This is happening all over America today And when our boys come home again — from India and China and Britain and Dutch Harbor and Australia and North Africa — they'll think of the world as they know it *really is.*

Not as isolated continents or separate hemispheres, but a clustering of nations whose *individual* welfare, in the peace to come, will depend upon the welfare of them *all.*

They know it can't be otherwise, when *no spot on earth is more than 60 hours' flying time from your local airport!*

In such a world, right now, we face

CONSOLIDATED VULTEE AIRCRAFT

Your sales manager in Brisbane can attend a meeting in San Francisco on short notice. Flying time: 35 hours.

the necessity of waging and winning a global war. Tomorrow — in a world shrunk still smaller because of even swifter long-range planes to come — we and all other nations must somehow contrive to get along together as neighbors.

Air power — for peace

There are bewildering problems ahead. But one thing is certain. The plane — by accelerating the interchange of men, mail, merchandise, ideas, culture, and beliefs — will help to bring about a greater understanding between the peoples of the earth.

And without understanding, there can be no lasting peace.

(Orthographic projection, centered on London)

A plane recently *flew the 1400 air miles from London to Moscow on a special mission in the morning, returning that same afternoon. Top speed: 400 M.P.H.*

(Polar azimuthal equidistant projection)

Today's planes, *with their tremendous speed and long flying range, need not follow old established trade routes. The 9400-mile sea route from New York to Bombay is about a 3-week voyage, but the air route is only 7790 miles. Flying time: 39 hours or less.*

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

San Diego, Calif. • Vultee Field, Calif. • Fort Worth, Texas
New Orleans, La. • Nashville, Tenn. • Wayne, Mich.
Allentown, Pa. • Tucson, Ariz. • Elizabeth City, N. C.
Louisville, Ky. • Miami, Fla.

Member, Aircraft War Production Council

QUICK FACTS FOR AIR-MINDED READERS

Consolidated Vultee designed and perfected the long-range Liberator bomber — was the first to turn out multi-ton bombers in volume production on a moving assembly line.

• • •

Because teamwork means more bombers and an earlier victory, the Consolidated-designed Liberator is also being produced by Ford, Douglas, and North American.

• • •

Liberators and Catalinas have helped to provide a "complete shore-to-shore air cover" spanning the Atlantic as protection for convoys against Nazi submarines, according to joint statement by British Admiralty and Air Ministry.

• • •

All transport planes, including the Liberator Express, are being equipped to carry standard stretchers for the evacuation of wounded, according to the Office of War Information.

• • •

To protect Australia's 11,000-mile coastline, the Royal Australian Air Force chose Catalinas as ships that can regard "journeys of 2000 miles or more as routine. Catalinas can remain in the air for thirty hours and can reach Australia's remotest bases and return without refueling," according to the Commonwealth of Australia Department of Information.

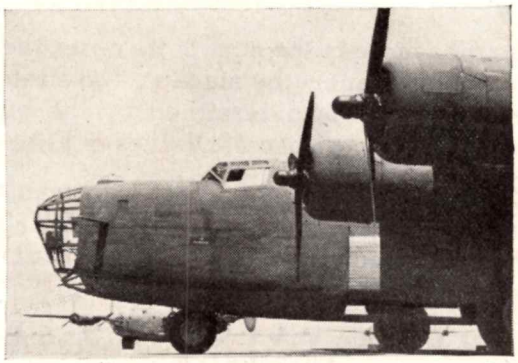
• • •

At the end of 1943, the United States will have about 865 airports, each with paved runways of 3500 feet or more. This compares with less than 100 such airports in 1940.

• • •

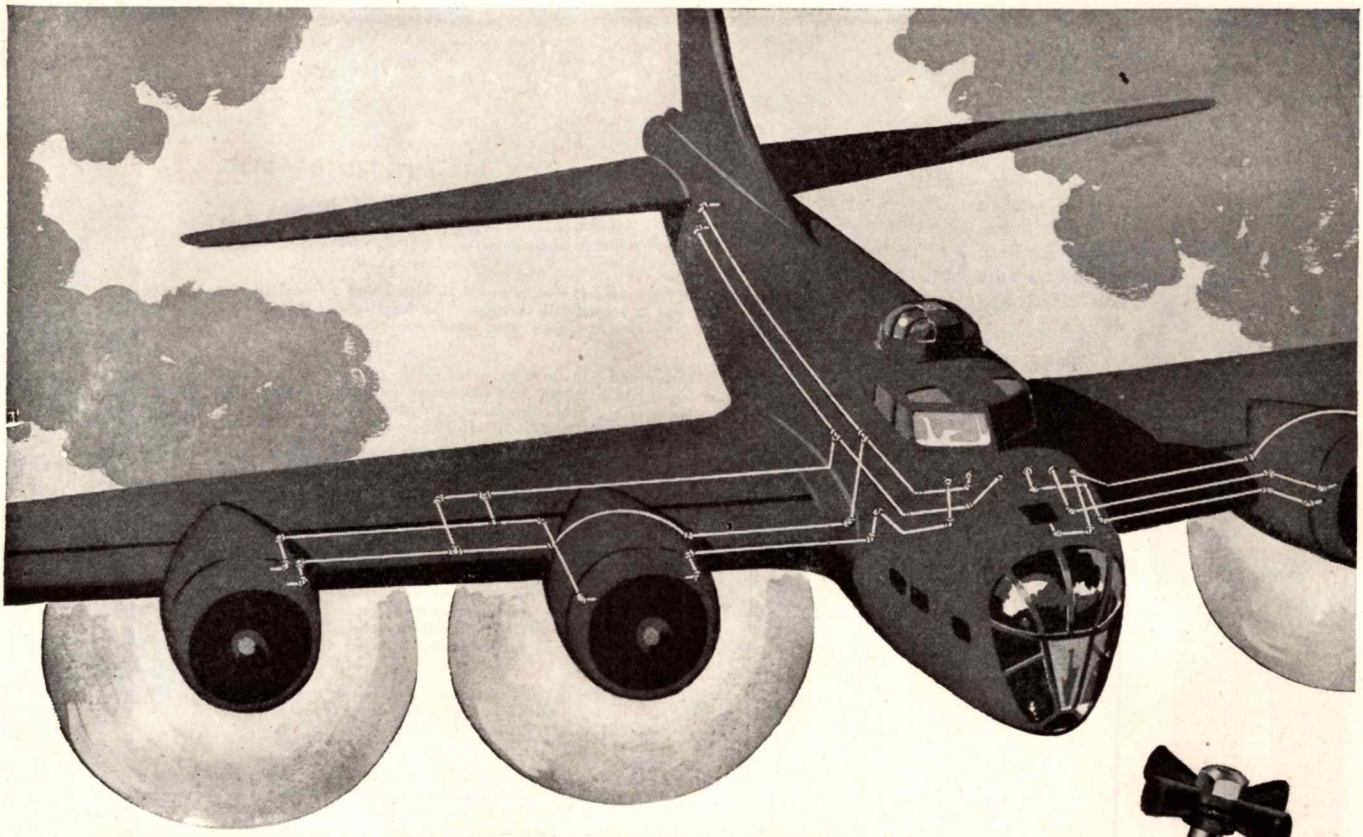
There are 11 Consolidated Vultee plants in the United States. If these 11 plants could be put under a single roof, they would occupy a building 3 miles long and 5 city blocks wide.

In addition *to the Liberator bomber, Liberator Express transport plane, and the Coronado and Catalina patrol bombers, Consolidated Vultee also builds dive bombers, trainers, and torpedo planes.* Above: *the Valiant — basic trainer widely used by the Army, Navy, and Marine Corps.*



"O.K. for take-off!" *Another huge Liberator bomber rolls off Consolidated Vultee's moving assembly lines into the hands of the test pilots. On every aerial battle front, the speed, range, fire power, and precision bombing of the 4-engine Liberator is helping to transfer the Axis dream of victory into a nightmare.*

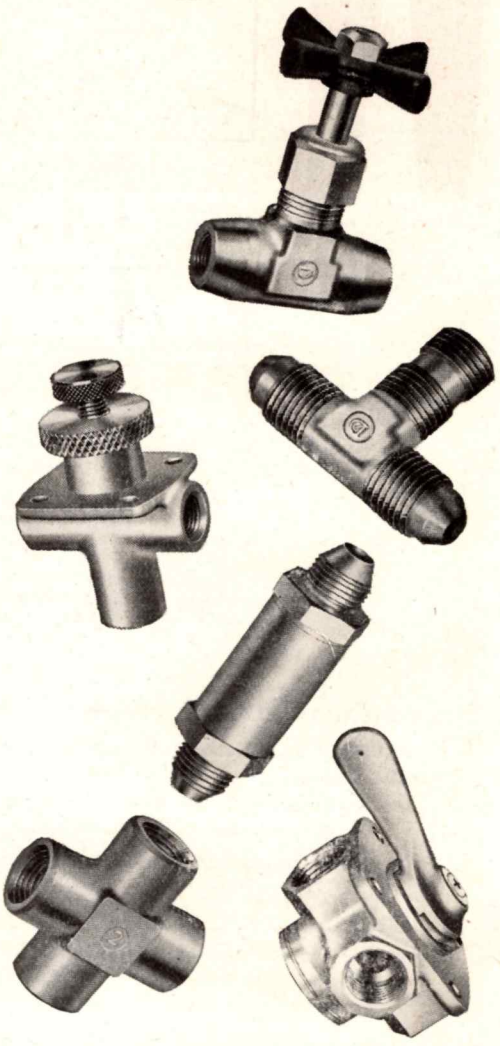
LIBERATOR (4-engine bomber) — CORONADO, CATALINA, (patrol bombers) — P4Y (anti-submarine plane) — LIBERATOR EXPRESS (transport) — VALIANT (basic trainer) — VENGEANCE (dive bomber) — SENTINEL ("Flying Jeep") — RELIANT (navigational trainer)



THE BIGGEST BOMBER DEMANDS

DEPENDABILITY

IN ITS SMALLEST PART



● Just as the whole is the sum of its parts, the quality of the whole airplane—the stamina, the strength, the battle superiority—is determined by the *quality* of small parts like Dole Aircraft Valves & Fittings.

This fact is recognized by every workman, woman, engineer, inspector and executive in Dole's plants and offices . . . and shows up in the product as uniform dependability.

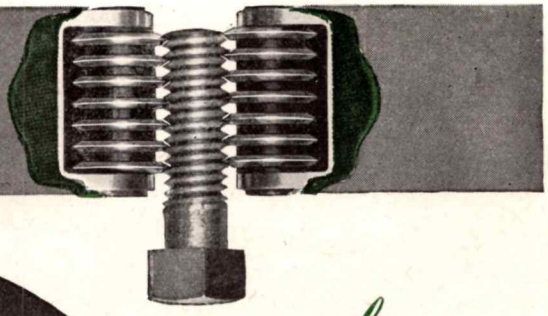
THE DOLE VALVE COMPANY
Established 1906
1901-1941 Carroll Avenue, Chicago, Illinois
Los Angeles • Detroit • Philadelphia

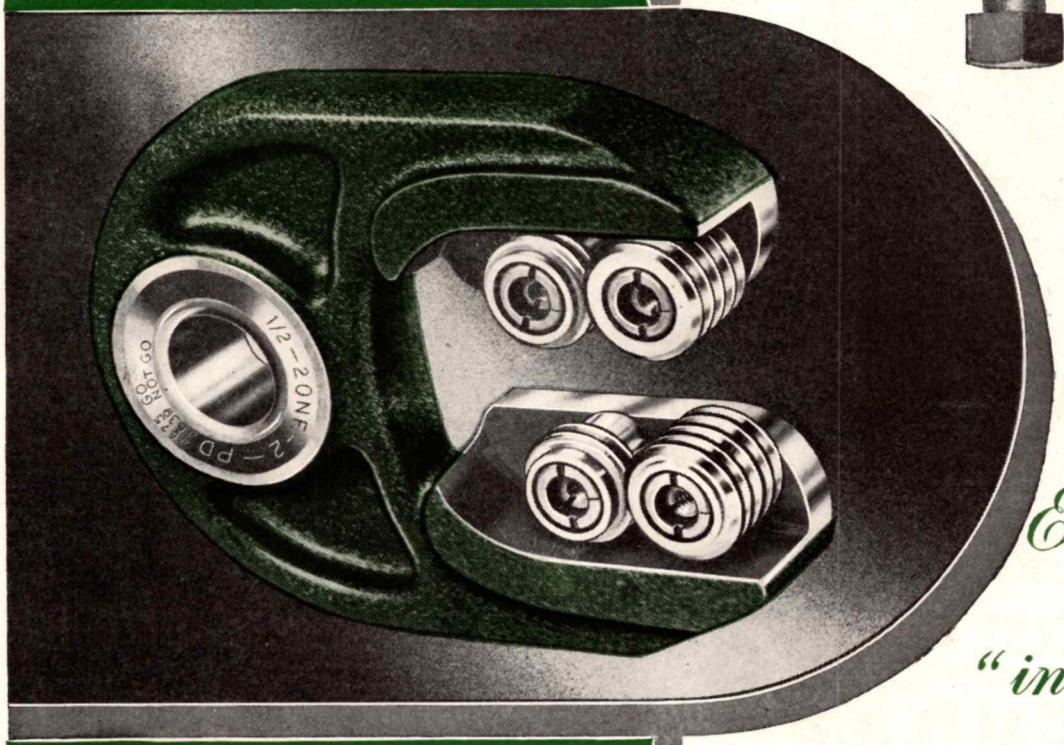
DOLE

★ Made in Accordance with Army-Navy Aeronautical Standards ★

AIRCRAFT VALVES AND FITTINGS

NOW-YOU CAN GET





for Speedy Accurate Economical "in process" gaging of Threaded Parts

Greenfield John-Sons ROLL THREAD SNAP GAGES

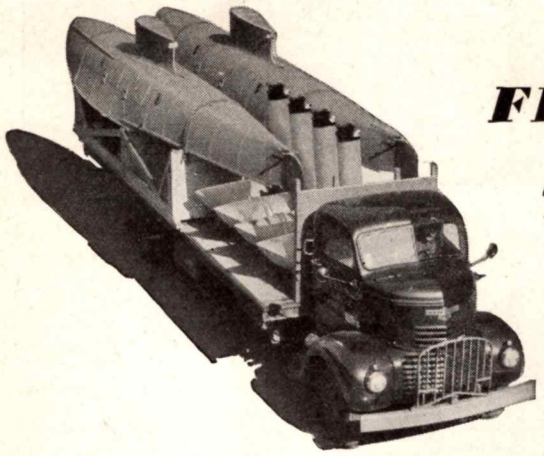
GREENFIELD TAP AND DIE CORPORATION
GREENFIELD, MASSACHUSETTS
DETROIT PLANT: 5850 Second Blvd.
WAREHOUSES in New York, Chicago, and Los Angeles
In Canada: GREENFIELD TAP AND DIE CORP. OF CANADA, LTD., GALT, ONT.

The Roll Thread type of Snap Gage is ideal for gaging work on the machine. Its open end construction permits rapid application of the gage to the threaded part. The rotating rolls increase the life of the gaging ribs and the effective life of the gage.

Now you can get Roll Thread Snap Gages from "*Greenfield*," the source you've always looked to for quality gages to guard the accuracy of your product. Send at once for descriptive booklet, giving complete information, and instructions for ordering Roll Thread Snap Gages.

GTD GREENFIELD

TAPS • • • DIES • • • GAGES • • • TWIST DRILLS • • • SCREW PLATES



FROM COLLEGE POINT . . TO THE SEVEN SEAS

Edo seaplane floats move in ever-increasing volume

Special trucks, carrying two complete seaplane float installations including wing tip floats, roll out through Edo's plant gates with time-table regularity.

18 years of "know-how" in the design and manufacture of all-metal seaplane float gear account for the ability of the Edo organization to maintain production schedules that meet the needs of a global war. Particularly, does this specialized experience count for exceptional performance in Primary Erection where highly skilled and trained craftsmen assemble the float structures—first bolting the bulkheads to the cross arms of multiple assembly jigs; then riveting the longitudinal members to the bulkheads; next riveting side and bottom sheets in place and making the floats ready for decking, water-testing, etc.

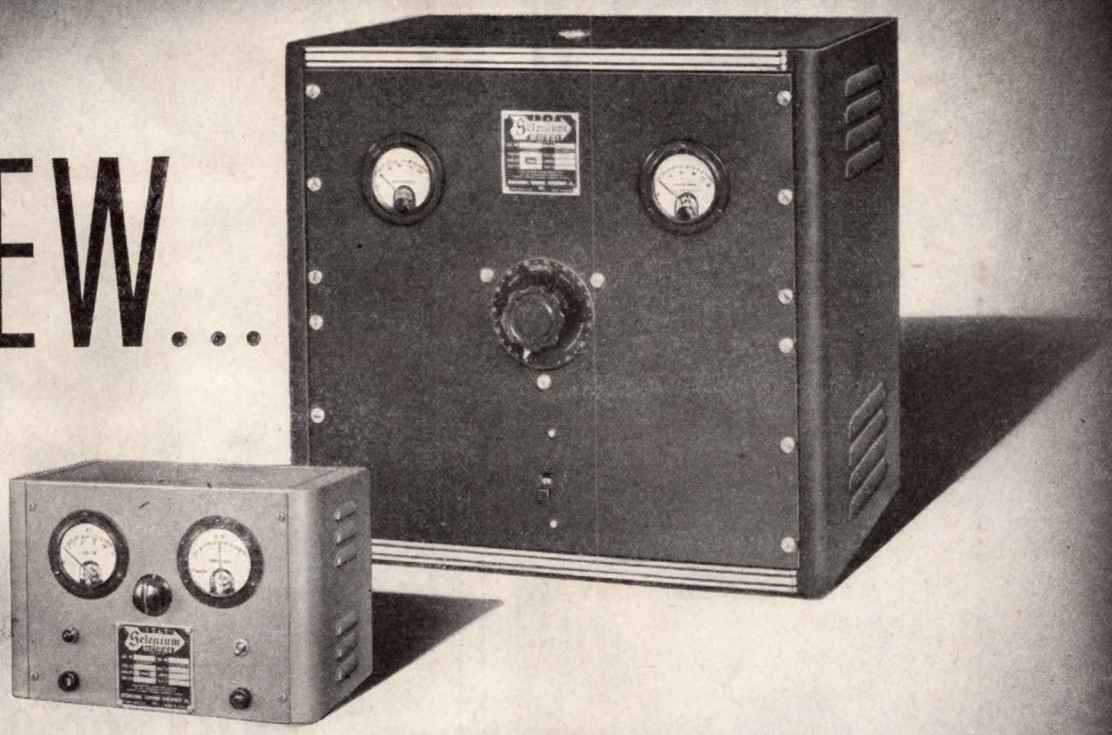
Modern, up-to-date tooling and processing technique providing accurate interchangeable parts for rapid mass production of assembly, contribute vitally to speed in the output of the Primary Erection department where Edo floats first take form. But experience is the prime factor in building a product of uniform quality in large volume—so that the "world's finest seaplane floats" may move in ever-increasing quantities to ramp, beach and catapult deck . . . to every operational point of our far-ranging seaplane squadrons.

EDO AIRCRAFT CORPORATION, 401 SECOND STREET, COLLEGE POINT, L. I., N. Y.

* **EDO FLOAT GEAR** *

SERVES THE UNITED NATIONS

NEW...

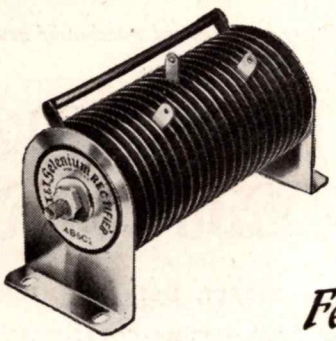


A complete line of Federal Battery Chargers Powered by I. T. & T. Selenium Rectifiers

Now – to users of battery charging equipment – we present a complete line of Federal battery chargers, of wide voltage and practically unlimited current range, covering every need and purpose.

And – to the manufacturer requiring battery chargers of special design – we offer our complete Federal design and manufacture service, geared to handle your requirements promptly.

All Federal battery charging equipment is powered by long-life, trouble-free I. T. & T. Selenium Rectifiers – accepted as standard by the electrical industry.



For powering production lines and for use in military devices, Federal also manufactures a complete series of general purpose power supply equipment. Consulting Engineering service available. For descriptive bulletins write *Department A.*

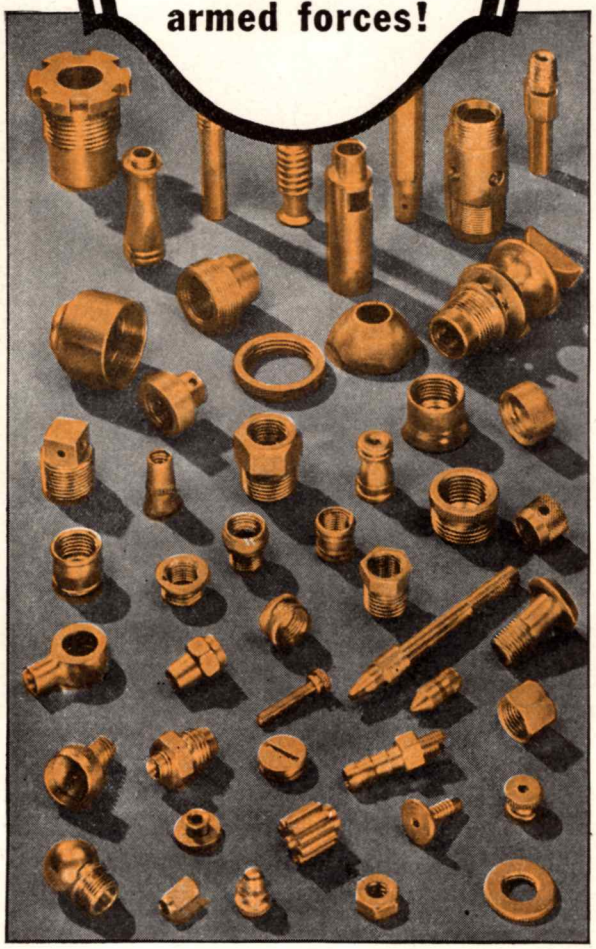
SELENIUM RECTIFIER DIVISION

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

1000 Passaic Ave.
East Newark, New Jersey

THE
CHICAGO SCREW CO.
serves the armed forces!



(Above illustration reproduced in miniature)

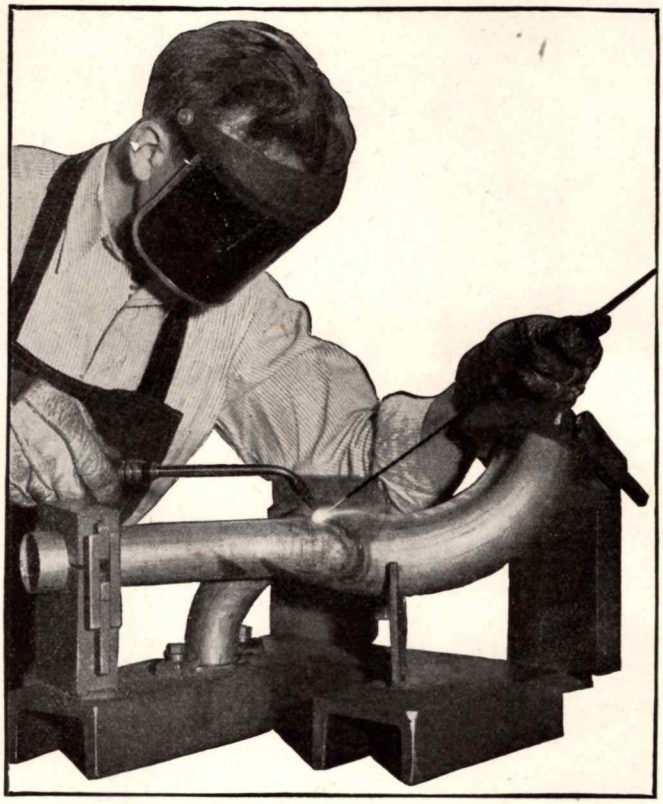
"CHICAGO QUALITY" SCREW MACHINE PRODUCTS

We are turning out Brass Screw Machine Products by the millions—to exacting specifications for tolerances and "finish"—for our fighting forces.

Our unsurpassed facilities—under constant metallurgical control—guarantee our products meeting the highest standards required by "AIRCRAFT QUALITY"!

ARMY E NAVY

THE CHICAGO SCREW CO.
ESTABLISHED 1872
1026 So. Homan Avenue Chicago, Ill.



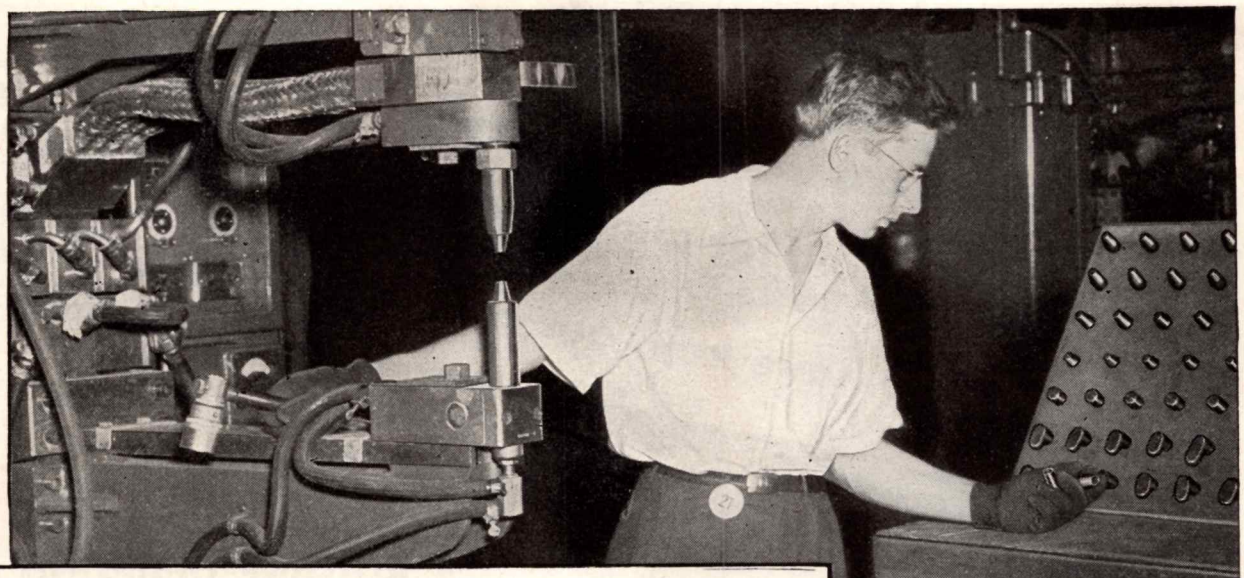
SKILL COUNTS IN AIRCRAFT WELDING!

★ Organized more than five years ago for the sole purpose of serving the Army Air Forces, as well as the more prominent airplane manufacturing companies, this company is in an unique position since its entire personnel and experience have been used in the development of men and facilities for the production of airplane parts and assemblies. Welding technique, particularly, has been developed to a high degree, and through recent increases in facilities and personnel, *we are now ready to offer the welding experience of this company to a limited number of new customers.*

KAY PRODUCTS COMPANY

4825 CABOT STREET, DETROIT, MICHIGAN
DIVISION OF TYLER FIXTURE CORP., NILES, MICH.

AIRCRAFT WELDING



Spot Welding Efficiency Starts *Before* the Operation

PHOTOGRAPH COURTESY CURTISS-WRIGHT CORPORATION

Successful spot welding depends on accurate control of electrode pressure, current, position of parts, cooling and dressing of electrodes.

Welders save man hours—conserve essential raw materials . . . do a better resistance welding job, too . . . by planning *ahead* of the actual machine operation.

It is small wonder then, that aircraft manufacturers, working at top speed to get planes to the four corners of the earth, pioneer in welding progress. Among the many aids to efficiency are the racks (shown in photograph) in use at Curtiss-Wright affording complete visual selection of all types of Mallory electrodes. The pigeon-hole section below contains correctly-welded samples, as well as unwelded samples of the material by which the operator can test the machine before starting production welding. By means of these samples, all adjustments of Mallory electrodes and of the amount of current are made.

Selection of the best electrode materials, designs and cooling methods for spot, seam, flash, butt or projection welding is not easy . . . but the right answers in any specific application will speed output tremendously. Mallory metallurgists are at your service to give those answers. They can help you produce better welds faster, and at lower cost.

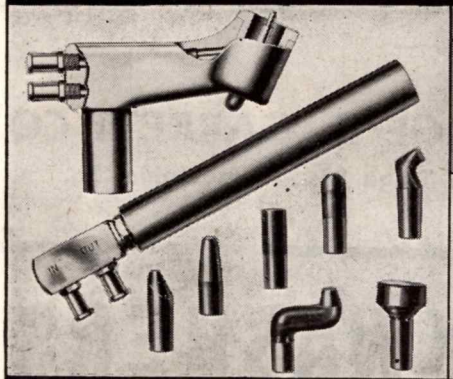
Write today for specific data; if you'd like a free copy of the Mallory Resistance Welding Data Book, mention it in your letter.

P. R. MALLORY & CO. Inc.

MALLORY

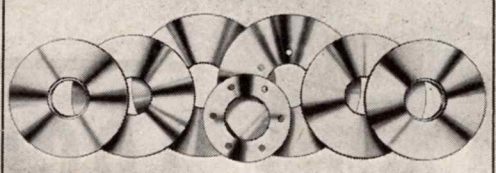
P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
Cable Address—PELMALLO

Standardized Resistance Welding Electrodes

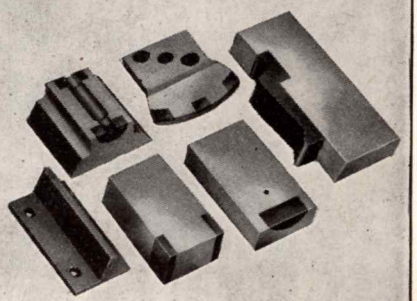


SPOT WELDING TIPS AND HOLDERS

Speedier Production
Less Down Time
Better Welding • Lower Cost



SEAM WELDING ROLLS



FLASH, BUTT, PROJECTION WELDING DIES

"IMPOSSIBLE DELIVERIES" A ROUTINE DIAMOND G JOB

Time and again production managers of America's war plants are amazed at the almost impossible deliveries Diamond G gives. The reason? We're set-up for speed . . . mass production . . . and quality from the office door to the shipping platform.

Special patented machines turn out washers by the millions instead of the usual thousands . . . precision heat treating methods assure Nth degree accuracy in hardening and tempering . . . scientific controls build *Controlled Tension* into every Diamond G Washer.

If you need flat washers or lock washers in record time get in touch with us. We are ready to supply you with all kinds of washers from No. 0 (1/16" IDO) to 2" lock washers . . . steel, cadmium-plated, bronze, or stainless steel . . . AN 935 series as well as aviation flat washers . . . AN940, AN945, AN960 and AN970. To step-up your production line . . . deliveries . . . and quality, send your order for Diamond G Washers to —

GEORGE K. GARRETT CO.
D & Tioga Sts., Philadelphia, Pa.

LOCKWASHERS

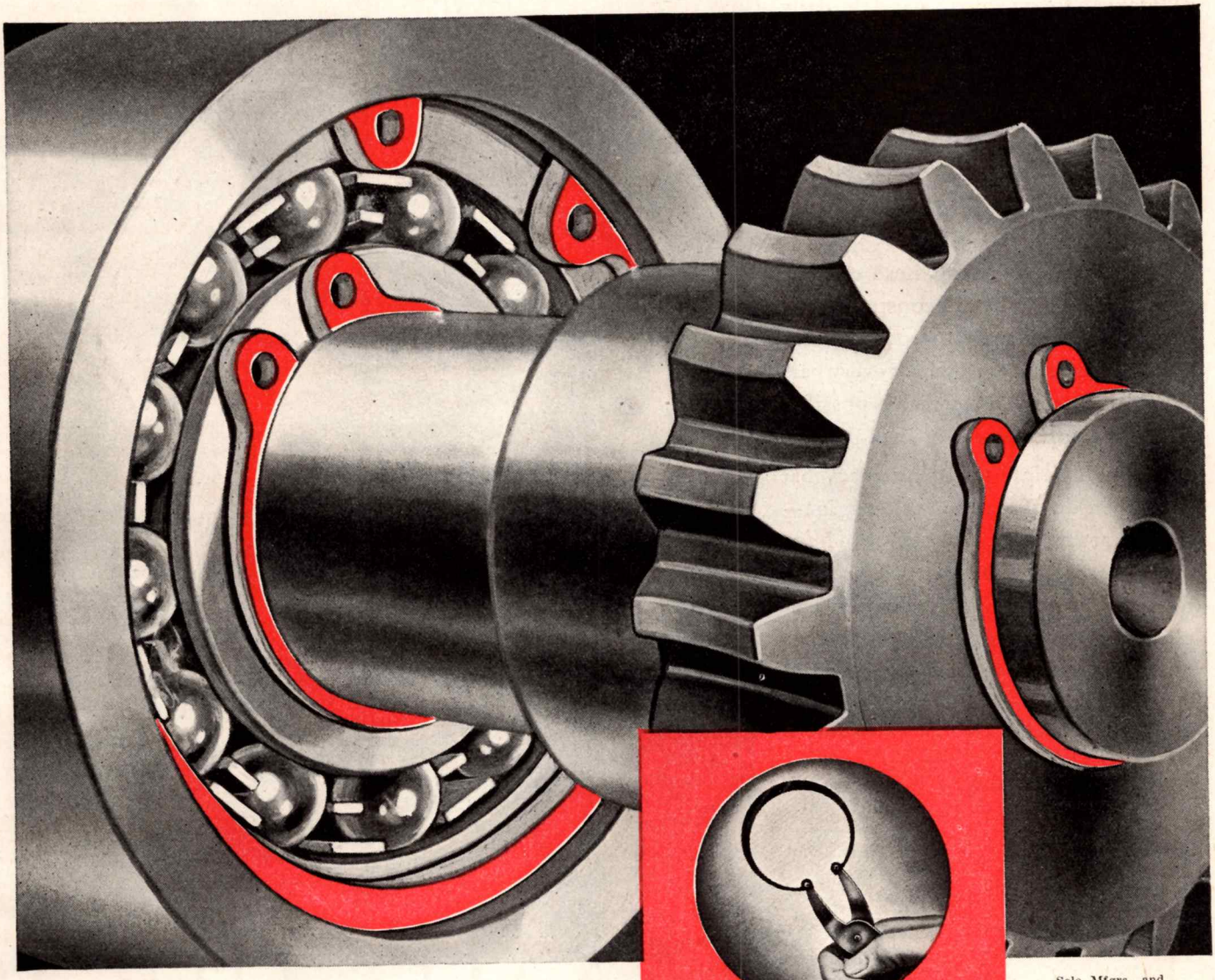
Waldes Truarc presents a significant advance in retaining rings.

It spreads or contracts without distortion; always retaining its perfectly fitting circular contour.

WALDES TRUARC RETAINING RING

For thrust-load fixing, and shaft and housing applications, Waldes Truarc provides distinct advantages over nuts and bolts or wedges and washers... it reduces dimension and weight... saves material... cuts manufacturing time... simplifies assembly and dis-assembly.

On request, we will gladly furnish samples and full data for your tests.



U.S. Patent
Re 18144

Sole Mfgrs. and
Licensees in U.S.A.

WALDES KOH-I-NOOR INC ★ LONG ISLAND CITY, N. Y.

★ *Back from a bombing mission—an engine missing—a rudder all but shot away. Under trees, on sandy deserts, our skilled Air Corps mechanics are "keeping 'em flying"—within earshot of enemy guns.*

Get 'er *Flying* in a hurry

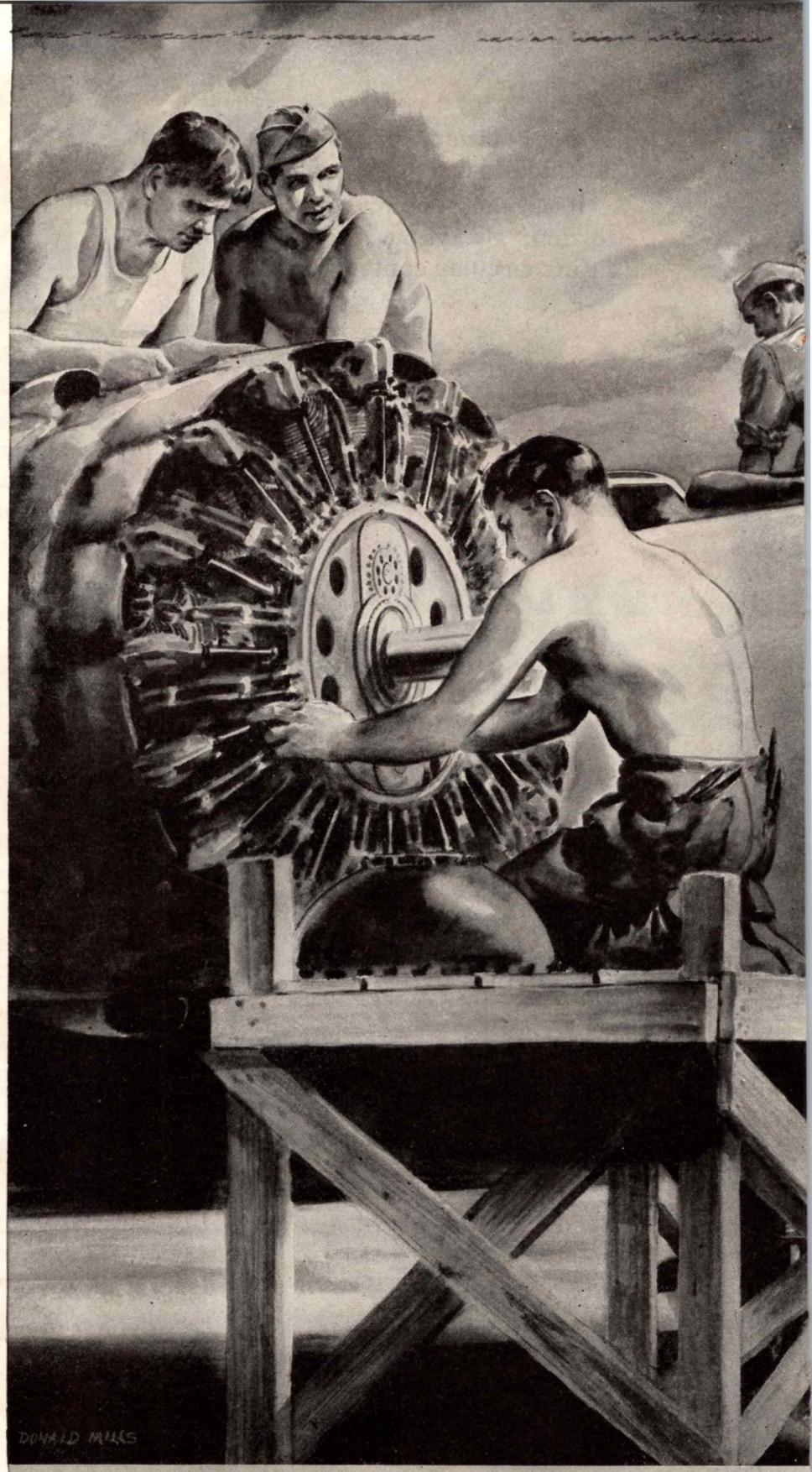
When a mission must be carried out, there is no time to baby an airplane! The machine shop may be under a tree with the sky for a hangar roof, but the orders are: "Get 'er flying—in a hurry!"

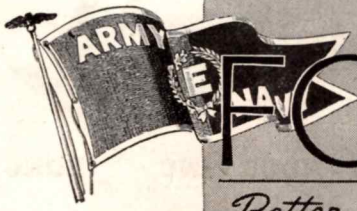
It takes a tough ship to stand the daily pounding these missions entail. It takes a tough engine to keep that ship flying with minimum time out for repairs and overhauls. And this is the job that Pratt & Whitneys are performing—a job that is writing their fame in smoke and fire over Axis-ruled lands.

But the toughness of these engines comes, not from rugged construction—not from "beefed up" parts, but from the close tolerances to which every part is held—a precision that makes possible great strength coupled with lightness.

The lightweight precision gears that have been developed for this engine—gears that are today being made in huge quantities at Foote Bros.—give promise to American manufacturers of new efficiency and new economy in the transmission of power when the war is won.

FOOTE BROS. GEAR AND MACHINE CORPORATION
5225 S. Western Boulevard • Chicago, Ill.





FOOTE BROS.

Better Power Transmission Through Better Gears

25 YEARS Experience AT YOUR SERVICE!

L. M. PERSONS Corporation
ENGINEERS & MANUFACTURERS

August 1, 1943

TO: AIRCRAFT ENGINEERS:—**SUBJECT**: AIRCRAFT CONTROLS

PERSONS AUTOMATIC AIRCRAFT CONTROLS ARE DESIGNED AND MANUFACTURED TO SPECIFICATIONS. INCLUDE:

AIR SPEED SWITCHES
PRESSURE SWITCHES...for warning indicators, motors and valves.
TEMPERATURE CONTROLS...for engines and accessories, cabin heat and de-icing equipment.
CARBURETOR CONTROLS...for critical pressure and temperature compensation.
FLAP & GEAR CONTROLS...for setting cowl flap, wing flap, trim tabs and landing gear.
SOLENOIDS...for bomb racks, starters, guns, bellows pumps, latches and controls.
BELLOWS & DIAPHRAGMS...for controls and instruments.

FOR FAST, RELIABLE SOLUTIONS TO THESE OR ANY TEMPERATURE OR PRESSURE CONTROL PROBLEMS CONTACT...

L. M. PERSONS CORPORATION
ST. LOUIS, MO.

It will pay you to put your temperature and pressure control problems up to Persons. Backed by 25 years' experience, the recent Persons developments mentioned above have been engineered to specifications of many leading aircraft manufacturers. They have proved their merit in action. Let us show you how Persons Engineering and Manufacturing Service can save you vital, war-winning time and money. Phone, wire or write today.

L. M. PERSONS Corporation
ENGINEERS & MANUFACTURERS

6301 MANCHESTER BLVD. • ST. LOUIS, MO. STERLING 1100

Reanite

UNITES METAL TO METAL, OR RUBBER, PLASTICS, LEATHER AND WOOD TO METAL, OR TO EACH OTHER, WITH A BOND, IN MANY INSTANCES, STRONGER THAN THE MATERIALS THEMSELVES

The World of Tomorrow will be welded with a paint brush

EQUAL or superior to riveting or spot welding for many purposes, the Reanite Bonding Process* not only accomplishes substantial savings in production man hours, but through its unique ability to bond entirely unrelated materials permits design engineers to take full advantage of the specific properties of each.

The normal bond between metals exceeds 1000 lbs. psi on a pull test, and for some metals runs as high as 3000 lbs. On bonds formed between rubber and metal, or between wood and metal, wood and rubber, or between wood and wood, the materials themselves will give way before the bond.

Reanite is suitable for almost all metal surfaces — iron, steel, stainless steel, magnesium, aluminum, aluminum alloys, copper and bronze. It is particularly effective in bonding light metals such as magnesium and aluminum.

The Reanite Bonding Process is simple. Reanite adhesive is applied by brush or spray gun to the surfaces to be joined. Mild heat and pressure is applied.

The Reanite bond is insoluble in water, is *non-corrosive to metals,* and is effective through a temperature ranging from —40 °F. to as high as 300 °F.

Is Reanite available now? Yes. Reanite is formulated through cyclic modifications of materials high on the critical list, but for essential end-uses Reanite is available for immediate shipment.

**The Reanite Process is fully protected by United States and foreign patents, granted or pending.*

U. S. STONEWARE

AKRON, OHIO

REANITE — ANOTHER U. S. STONEWARE PRODUCT — PERFECTED UNDER THE IMPETUS OF WAR — DESIGNED FOR THE NEEDS OF PEACE

Whether it's a spot landing on a flat-top's pitching platform—or a spot-shot at a warship of the Slinking Sun, American skills combine to complete the mission. And Johnnie hits the spot with nice precision. Success becomes almost commonplace when repetition dulls the edge of novelty. But the wonder of it grows when one considers what American aviation has accomplished in the brief period since Pearl Harbor. Johnnie Tojo also hit a spot that December day—a tender spot that annoyed America into building the greatest Air Force in the World.

AIRCHOX COMPANY, Division of

JOYCE AVIATION, INC.

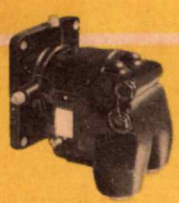
General Offices, 8S. Michigan Ave., Chicago

WORLD'S LEADING MANUFACTURERS OF AERONAUTICAL SAFETY EQUIPMENT

PESCO

PERFORMANCE CONTROLS THE AIR

North American Mustang



Hydraulic Pump featuring exclusive PESCO pressure-loaded principle.

ARMY E NAVY

There they go! Roaring cannons on wings! Swooping from the sky . . . strafing . . . spitting streams of savage steel. In their wake, the mark of America's might. Hats off to the performance of those daring Yankee raiders . . . and to millions here at home from whose skill stems plane performance that rules the sky.

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO *Pesco* FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO

More BOMBERS and FIGHTERS..

are **on their way** *with* **NEW**

Speed Nuts

Every day bombers and fighters are assembled with more and more SPEED NUTS. The increased use of SPEED NUTS rolls them off the line faster and lightens them for added useful load. These approved self-locking aircraft nuts grip the screws with a DOUBLE SPRING-TENSION LOCK that resists vibration for the life of the plane.

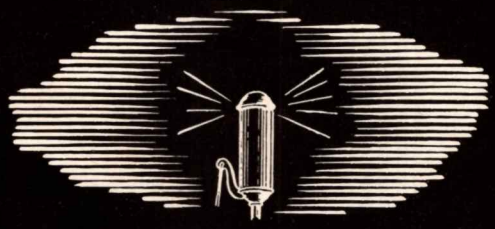
The tons of metal conserved with the use of SPEED NUTS is almost impossible to calculate And the man-hours assembly time saved runs into millions. Over 1500 shapes and sizes including many new ones just released. Approved for most all non-structural attachments by U. S. Army Air Forces and Navy Department Bureau of Aeronautics. Also used on trucks, jeeps and tanks. Write for our new book No. 185, illustrating some of our very latest developments.

TINNERMAN PRODUCTS INC., 2071 Fulton Road, Cleveland, Ohio

IN CANADA: Wallace Barnes Co., Ltd., Hamilton, Ontario

IN ENGLAND: Simmonds Aerocessories, Ltd., London

★ FASTEST THING IN FASTENINGS!



Dare We Speak of Peace?

Yes—because it means so much to all of us individually. With it will come again those products of industry like the car, the radio and the refrigerator, which never were luxuries so much as necessities. And those who are thinking in post-war terms are asked to remember that Weatherhead will be prepared to help build these products again as well as the many strange new ones destined to emerge from this war.

Look Ahead with

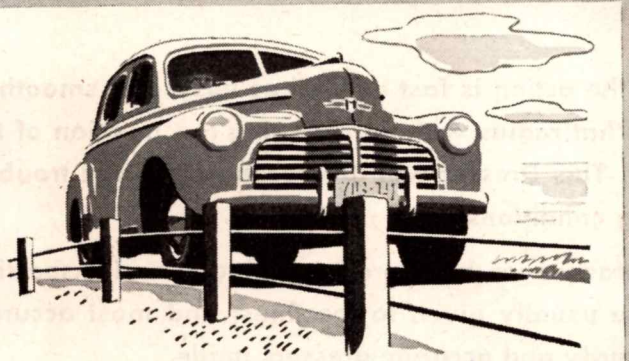
Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO
Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

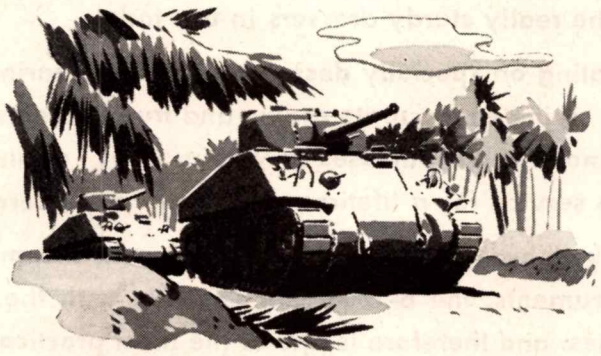
Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario

DELCO RADIOS

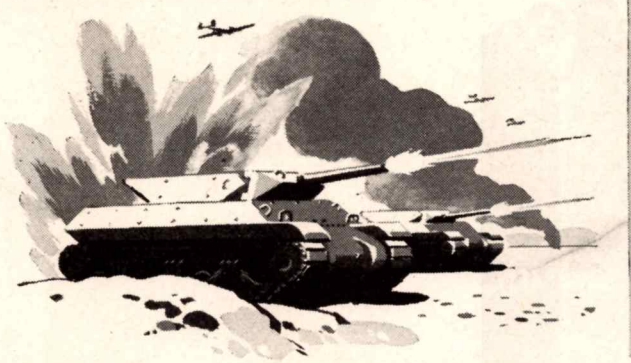
"BATTLE-PROVEN" EVEN *BEFORE* WAR STARTED!



Proved on the highways of peace . . .



to serve on the battlefields of war



Vibration—shock—intense heat and cold . . . Delco radios have been meeting these "war conditions" for years

The physical beating dealt out to radio sets used in tanks, tank destroyers and other *mobile* units is old stuff to Delco Radio engineers. For years, Delco Radio has been a leading manufacturer of automotive radios . . . having solved such problems as shock—vibration—heat and humidity—extreme cold—electrical interference. True, such punishment is more intense on vehicles of war . . . but actually they're the same old problems that Delco researchers had to lick to make automotive radio practical.

The important point today is not that Delco Radio pioneered and developed automotive radios to equip America's leading cars. What is significant is that this experience in vehicular radio problems has enabled Delco Radio, in cooperation with military technicians, to provide efficient inter-vehicle radio communication quickly.

The experience Delco Radio has gained down through the years thus helps speed the day of Victory . . . after which it will help enrich the days of Peace. Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

Delco Radio
DIVISION OF
GENERAL MOTORS

★ ★ ★ ★ **BACK THE ATTACK—WITH WAR BONDS** ★ ★ ★ ★

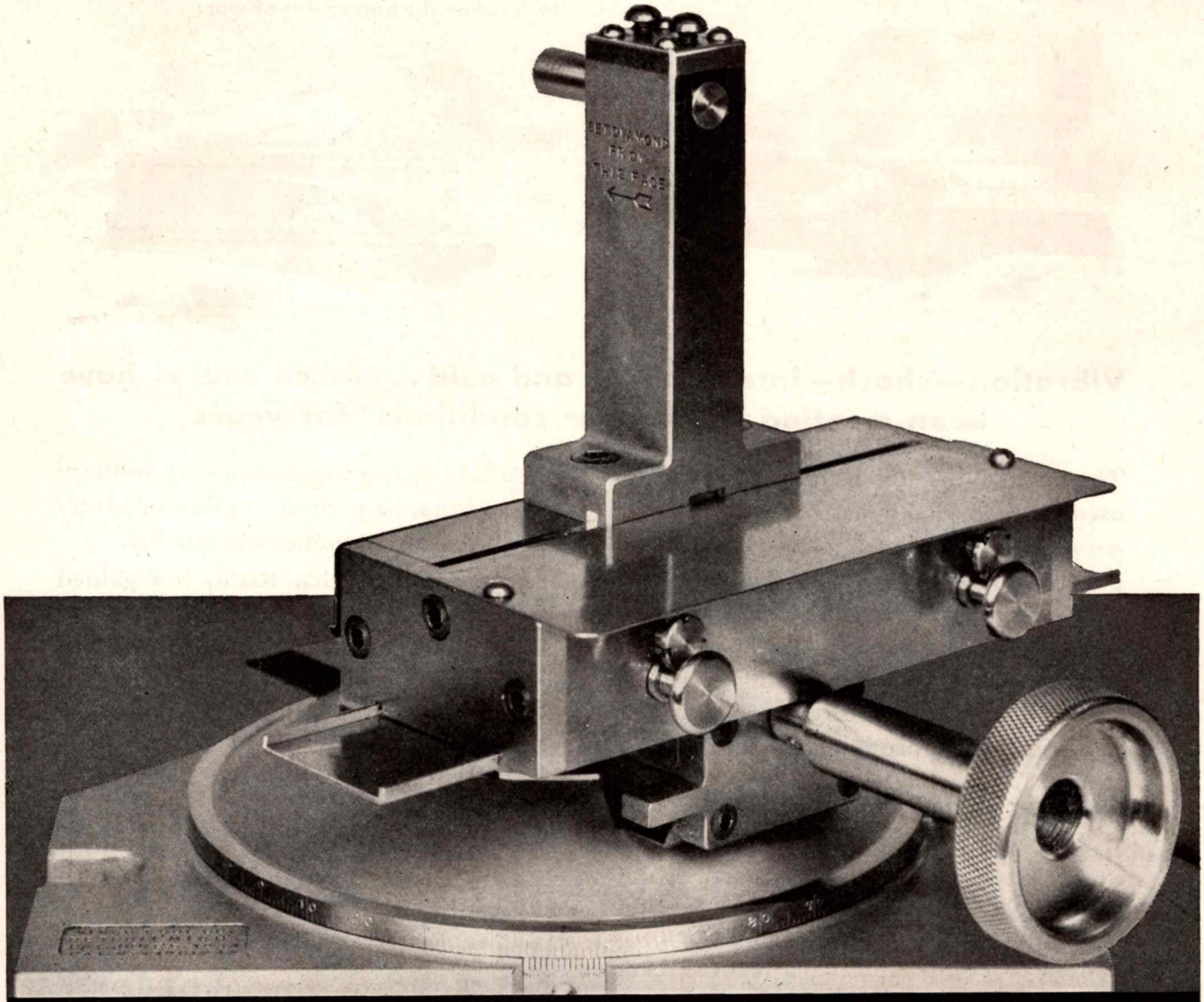
Practical, Sturdy, Accurate

The fact that every part used in its manufacture is carefully machined to a high grade of precision and assembled with care and accuracy, makes the VINCO (B-1) Angle Tangent to Radius Dresser one of the really sturdy dressers in use today.

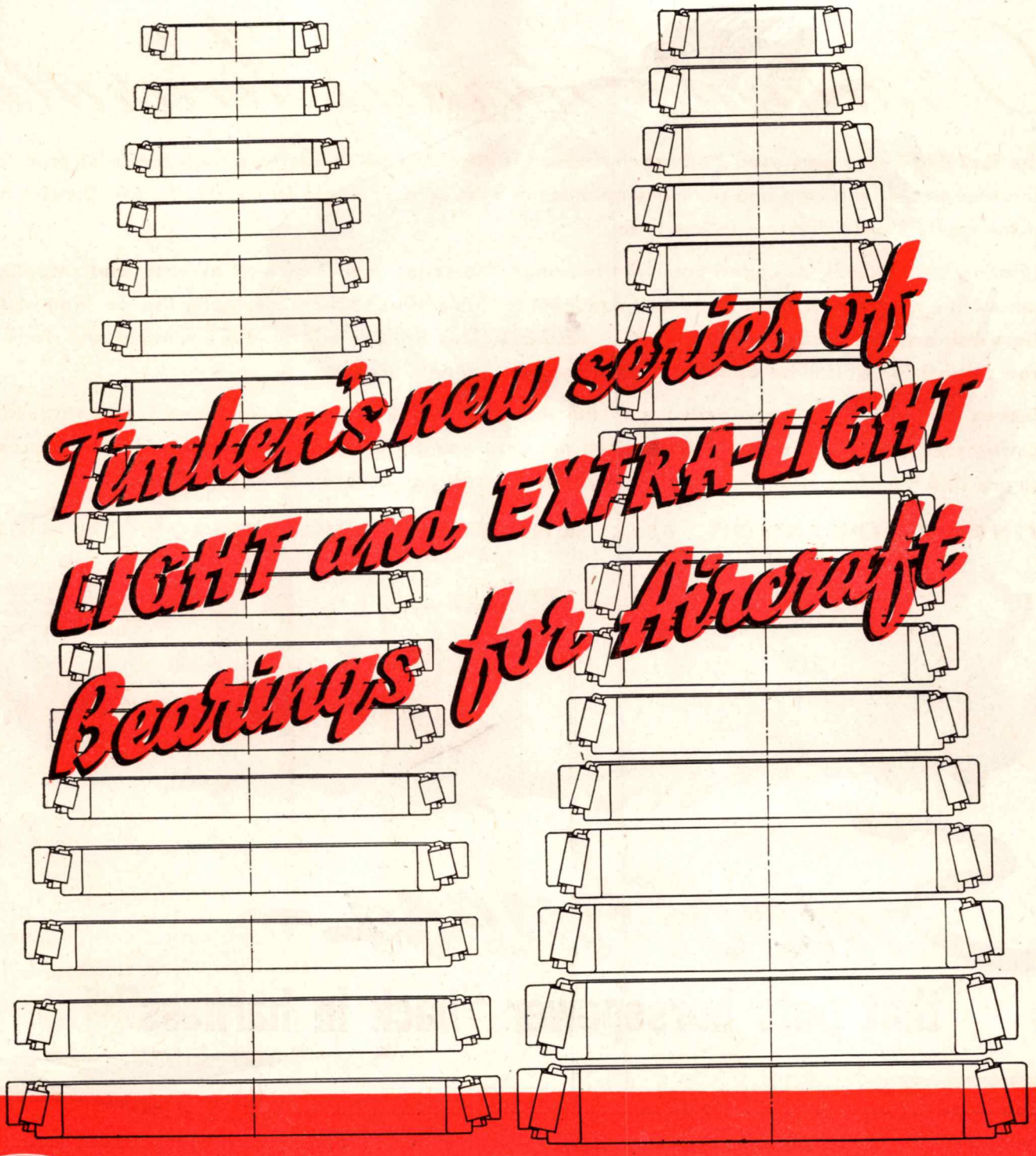
Rotating on specially designed precision bearings, the action is fast as well as easy and smooth. It can swing an accurate radius and true tangents to that radius without changing the position of the diamond, and it dresses to within .0001″ accuracy. This Dresser will give economical and trouble-free service for a lifetime under ordinary operating conditions.

Backed by VINCO's long experience in the manufacture of high precision gages and inspection instruments, the B-1 Dresser is made with the care usually given to the finest and most accurate gages, and therefore is one of the most practical, sturdy and accurate dressers made.

VINCO CORPORATION, 8863 SCHAEFER HIGHWAY, DETROIT 27, MICH.



MILLIONTHS OF AN INCH FOR SALE BY VINCO



Timken's new series of LIGHT and EXTRA-LIGHT Bearings for Aircraft

The bearings shown here have been reduced to approximately half size. For detailed drawings write The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Smoothness—

that puts horsepower "back in harness"

ROUGH FINISHES have a way of acting as horse thieves—they steal horsepower and subtract from a plane's performance. The fact that government specifications have been followed—and inspection tests passed—is no guarantee against this power-consuming roughness.

Thanks to long experience in the industrial field, Pittsburgh technical men have been able to develop camouflage finishes of extraordinary smoothness. They reduce wind resistance to a minimum—help the plane to cash in on all the horsepower the engines can generate.

These super-smooth finishes are a typical Pittsburgh achievement. In every one of our wartime formulations, we endeavor to put *plus*-over-minimum requirements.

Free Advisory Service: Pittsburgh maintains a force of "trouble shooters"—experts whose specialty is solving aircraft finishing problems. Whenever you need help, get in touch with us. One of our technical men is available for consultation.

PITTSBURGH PLATE GLASS COMPANY, Industrial Paint Division, Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Mich. The Thresher Varnish Co., Dayton, O.

PITTSBURGH *Industrial* **FINISHES**

PITTSBURGH STANDS FOR QUALITY PAINT AND GLASS

HILLS-McCANNA

provide

MAGNESIUM ALLOY SAND CASTINGS FOR THE AIRCRAFT INDUSTRY

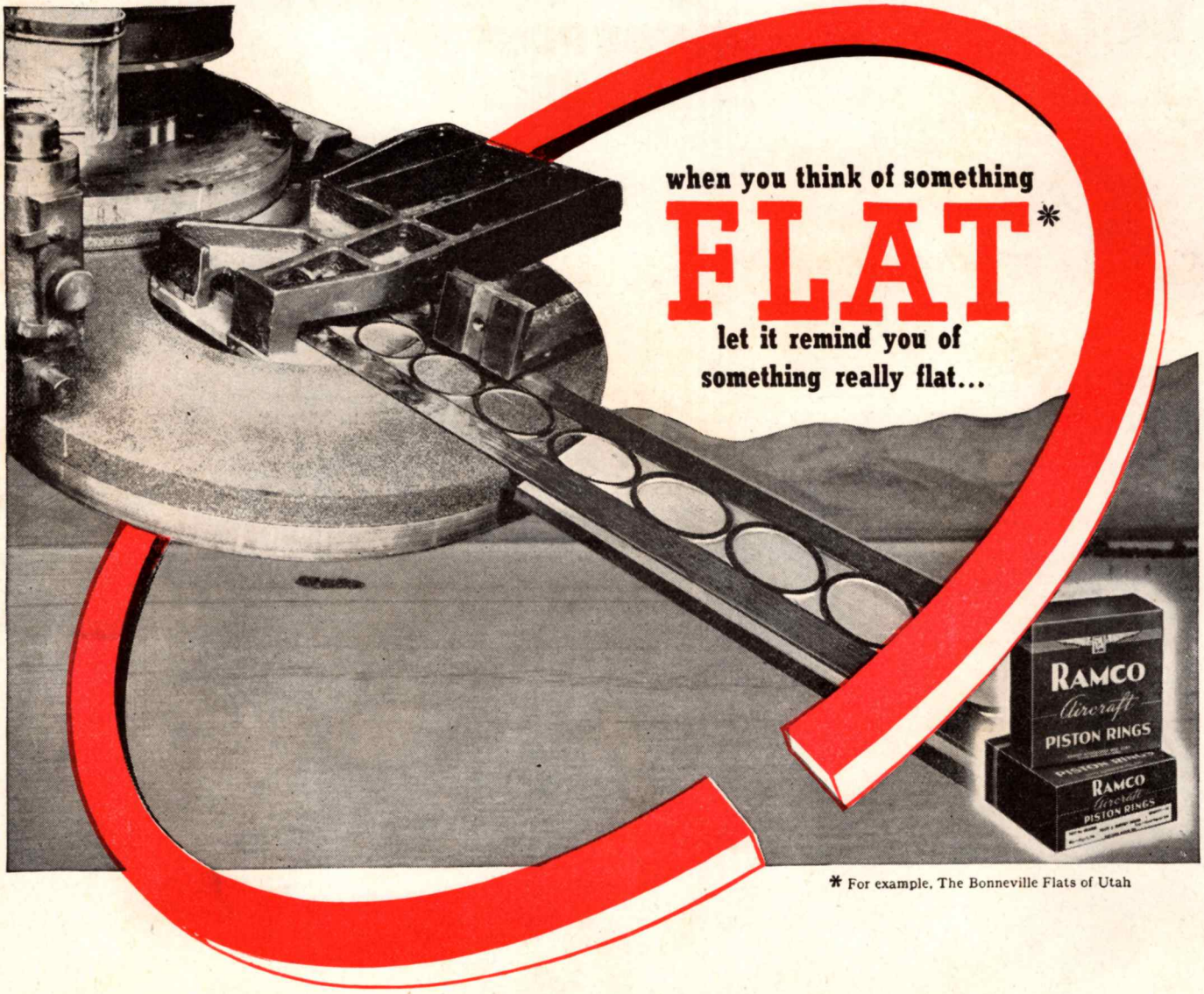
Our plant and organization are devoted 100% to war work for the duration, furnishing castings for engines, gun turrets, carburetors propellers, fuselage parts, brake and wheel assemblies, and other needs. Our long experience is at your service now to aid you in the furtherance of your peace time plans and products.

FOUNDERS OF NON-FERROUS ALLOYS SINCE 1870

HILLS-McCANNA CO

3013 North Western Avenue, Chicago, Illino

PROPORTIONING PUMPS · AIR & WATER VALVES · CHEMICAL VALV
MARINE VALVES · FORCE-FEED LUBRICATORS · DOWMETAL CASTIN



* For example, The Bonneville Flats of Utah

RAMCO MICRO LAP

AIRCRAFT PISTON RINGS

Micro-Lap is a product of the war emergency and Ramco's many years of engineering precision piston rings. It makes possible the lapping of piston rings to vitally important flatness tolerances in the millionths of an inch. It meets the need for more speed and absolute uniformity in the finishing of aircraft piston rings.

Ramco Micro-Lap exemplifies the many advancements in manufacturing made by Ramco in tooling up an entire new plant for the production of aircraft piston rings for military aviation.

A visit to this plant through the reprinted pages of a recently published magazine article will give you a quick picture of its completely modern facilities. Your request will bring a copy of this article to you without cost or obligation.

The facilities of this plant and that of our plants producing automotive, tank and industrial piston rings are available wherever they can be utilized to further the war effort.

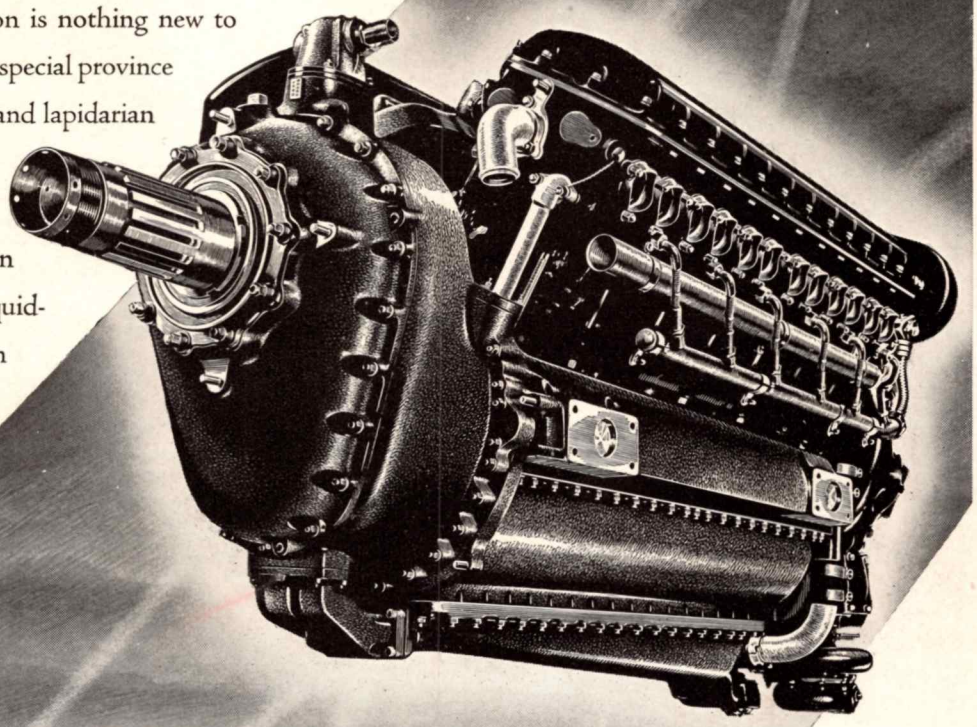
Address all correspondence to General Offices, Ramsey Accessories Manufacturing Corporation, 3700 Forest Park Boulevard, St. Louis, Missouri, U. S. A.

FOR VICTORY BUY WAR BONDS

Copyright, 1943, Ramco

BRILLIANCE WITH A PURPOSE

Like mirrors and jewels is the sparkle of polished metal parts in an Allison—but the eye cannot begin to see the perfection this brilliance reflects. ★ For one of the challenges in making aircraft engines is this... ★ To preserve—by exquisite accuracy of manufacture and finish—all of the inherent strength and endurance in every ounce of material used. ★ This need for perfection is nothing new to Allison. For years it has been our special province to handle metals with precision and lapidarian skill. ★ In today's tasks we are advantaged by all that General Motors has to offer in production techniques. ★ The result is a liquid-cooled aircraft engine which in performance can speak for itself — and an engine which we are resolved to make the finest in the world.



KEEP AMERICA STRONG
BUY MORE BONDS

POWERED BY ALLISON

P-38—Lightning
P-39—Airacobra
P-40—Warhawk
P-51—Mustang

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GM GENERAL MOTORS

OFF GUADALCANAL

GRUMMAN WILDCATS

SINK JAP DESTROYERS WITH MACHINE GUNS ONLY

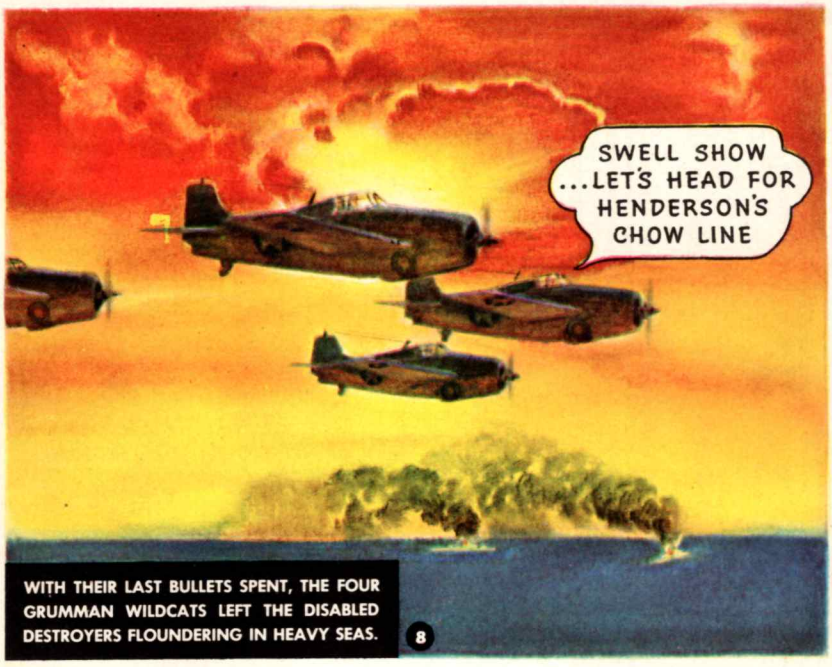
FOUR U. S. MARINE PILOTS IN GRUMMAN WILDCATS, RETURNING FROM PATROL TO HENDERSON FIELD AT GUADALCANAL, SPOT A BRACE OF JAP DESTROYERS SNEAKING ALONG THE COAST. ORDERED TO ENGAGE THE SURFACE CRAFT... WILDCATS ZOOMED UP INTO PROTECTING CLOUDS BEFORE DIVING INTO THE INITIAL ATTACK.

1

CAUGHT UNAWARE, SOON MOST OF THE JAP ANTI-AIRCRAFT BATTERIES WERE SILENCED OR EFFECTIVELY CRIPPLED.

4

5

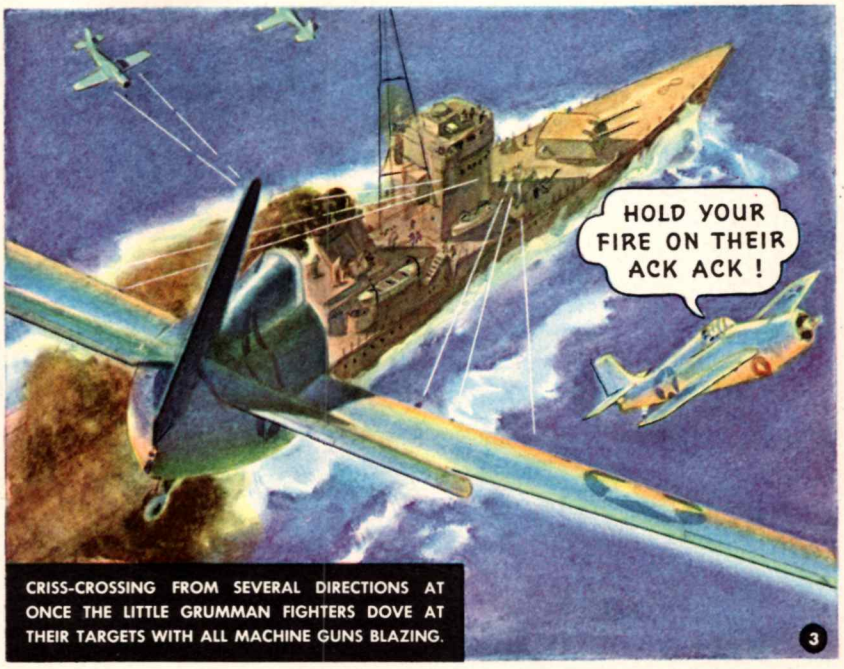


WITH THEIR LAST BULLETS SPENT, THE FOUR GRUMMAN WILDCATS LEFT THE DISABLED DESTROYERS FLOUNDERING IN HEAVY SEAS.

8

A FEW HOURS LATER . . . OBSERVATION OFFICER RETURNING FROM SEA PATROL REPORTS THE OUTCOME OF THE WILDCAT'S ENCOUNTER.

9



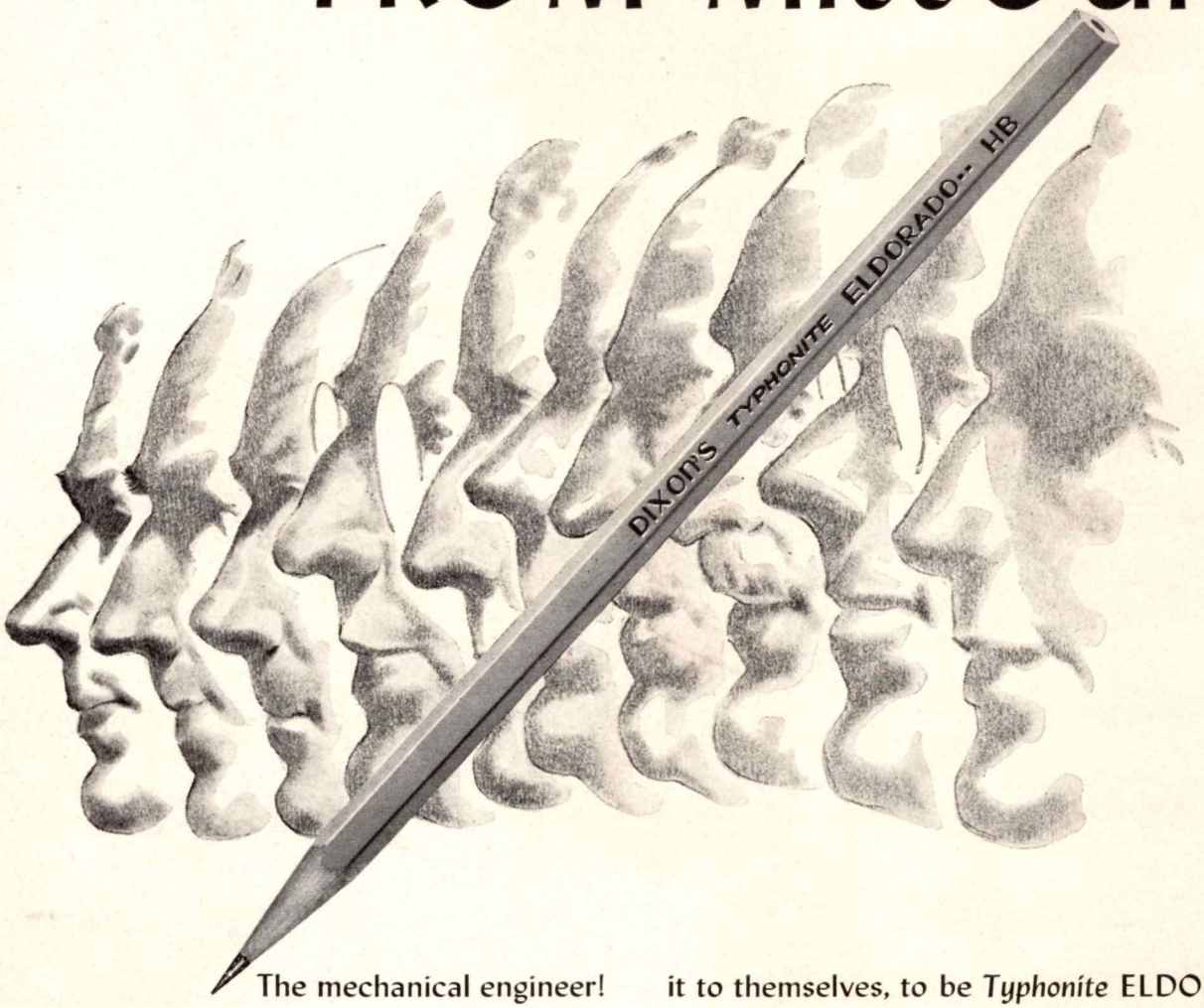
GRUMMAN

MAKES PLANES THAT MAKE HISTORY

Grumman

GRUMMAN AIRCRAFT ENGINEERING CORPORATION
BETHPAGE · LONG ISLAND · NEW YORK

TEN MEN FROM MISSOURI!



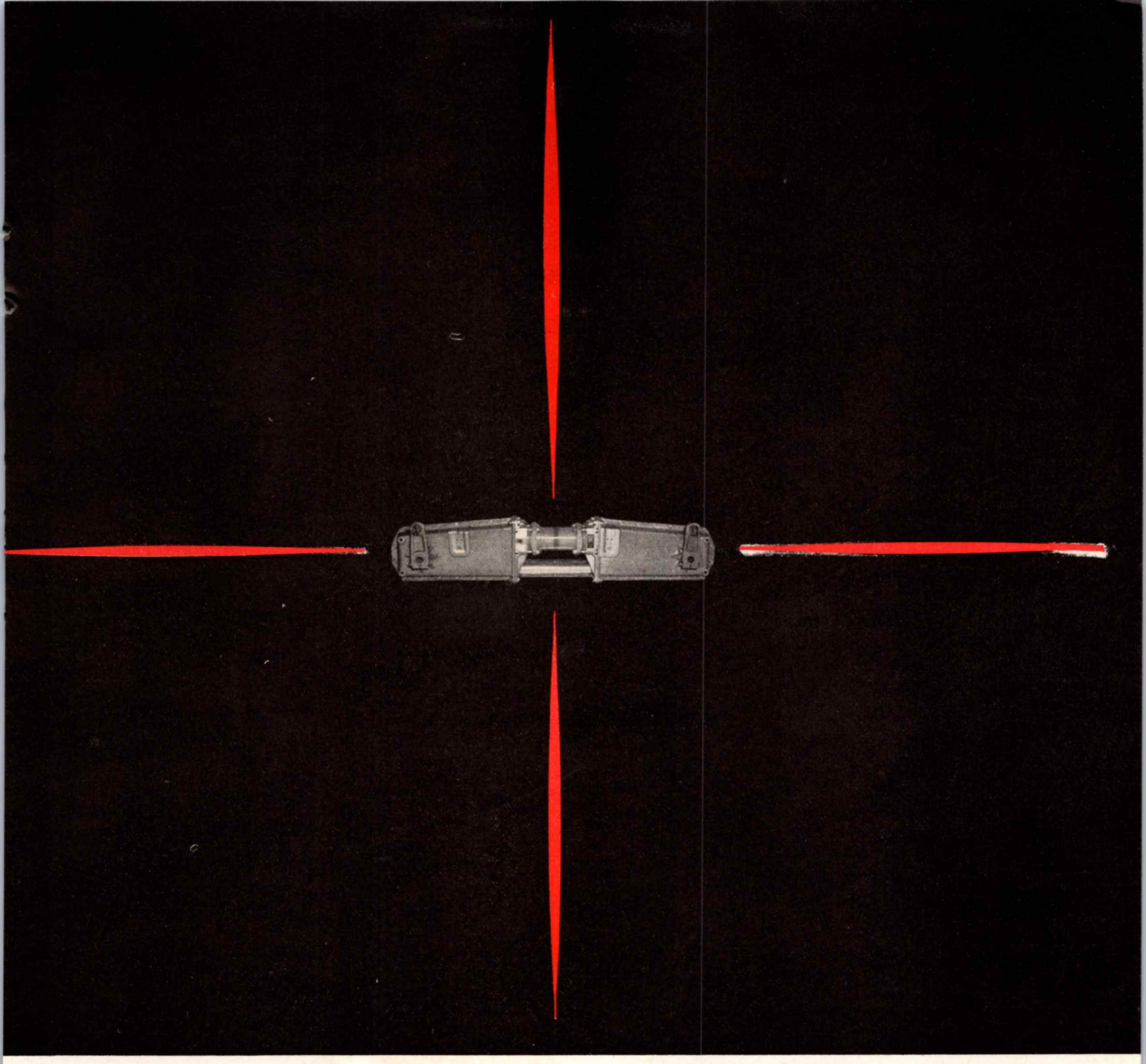
The mechanical engineer! The aeronautical designer! The architect! The art director! The civil engineer! The draftsman! The electronic engineer! The electrical engineer! The drafting instructor! The industrial designer! These men had to be shown before they'd admit which was the best drawing pencil. They are proving it to themselves, to be *Typhonite* ELDORADO.

Based on performance *Typhonite* ELDORADO pencils win. Typhonite leads are dustless, uniform, stronger. The blueprints of victory pour from the points of reliable Typhonite Eldorados.

Pencil Sales Dept. 39-J9
Joseph Dixon Crucible Company
Jersey City, N. J.

TYPHONITE

ELDORADO



HELP AVAILABLE . . . *to Producers of American Aircraft*

● RITTER facilities are now available for sub-contract work on certain aircraft parts and assemblies. Facilities included are a laboratory-controlled foundry, heat treating and X-Ray equipment for aluminum and bronze castings, equipment and skilled personnel for tool-making, precision machine work, plastic molding, electrical wiring, spray painting, plating and assembly.

Now in production are door-operating mechanisms (such as shown above), propeller-pitch control motors, manual tab controls, landing gear mechanisms, dual control columns, magnetic compasses. To this work, Ritter brings a 56-year experience as world's foremost producer of highest-quality Dental and Medical equipment.

If Ritter engineering and precision production facilities are of interest as a possible solution to a problem of yours, we solicit your inquiry. *Ritter Company, Inc., Ritter Park, Rochester 3, N. Y.*

ARMY E NAVY

Ritter

Precision Parts and Instruments for Aircraft

DO-ALL Cuts any material

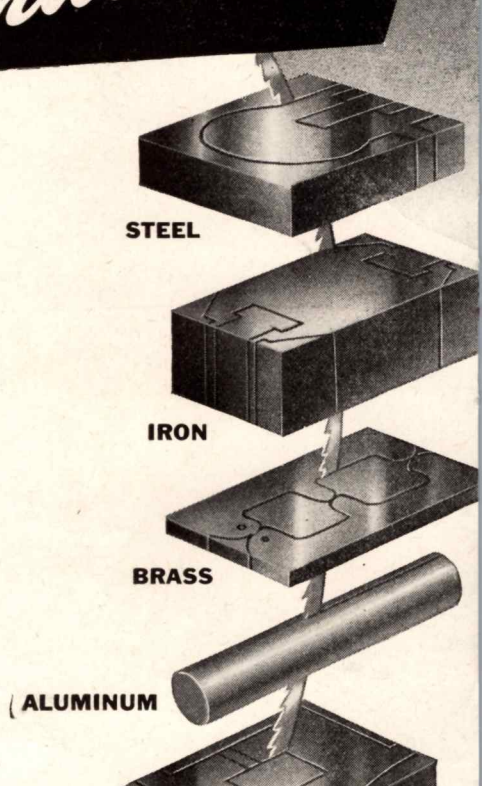
What have you that needs quick, smooth cutting—Metals? Alloys? Plastics? Plymetals? Rubber? Laminated Products? Composition Materials?

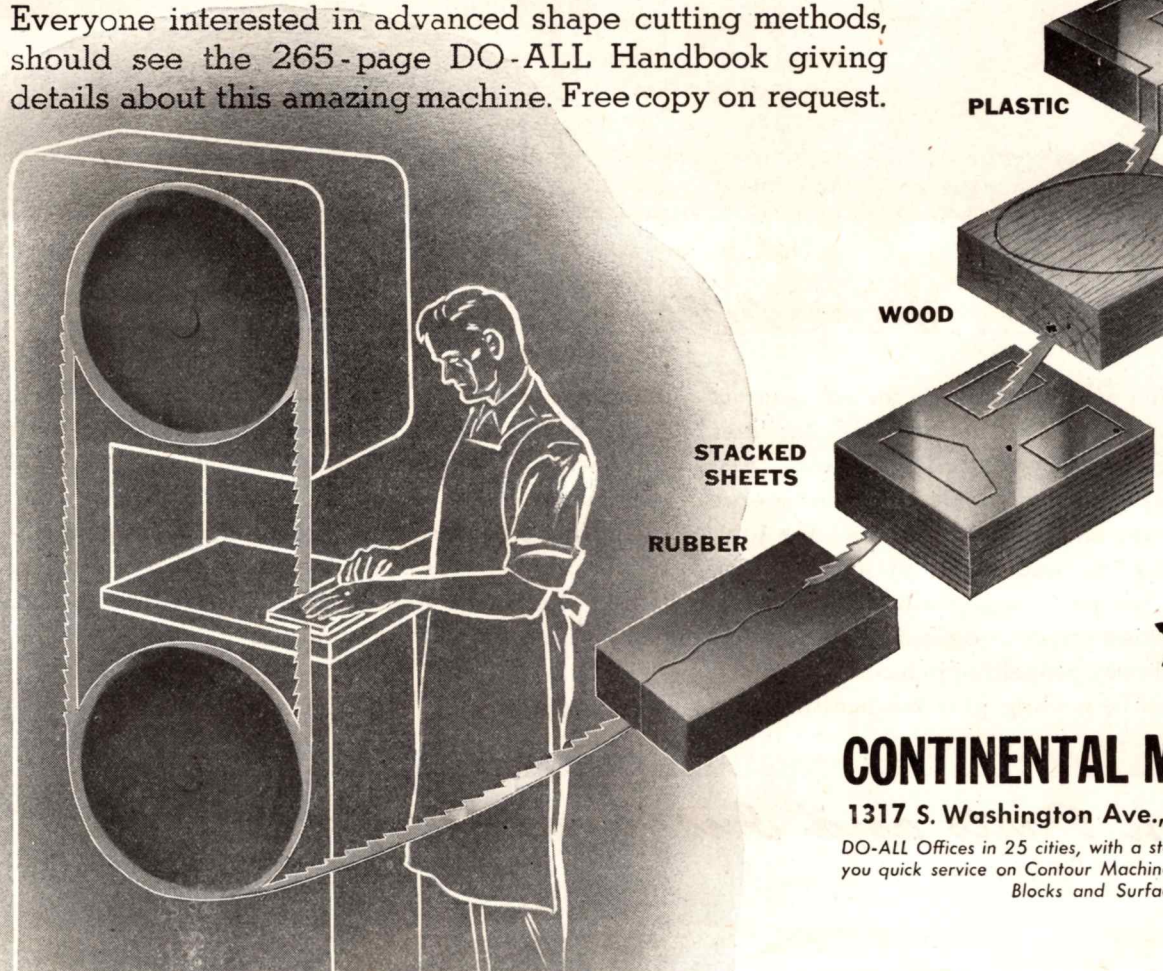
Armed with a DO-ALL Contour Machine and a supply of tough-edged DO-ALL Band Saws, you can tackle any internal or external sawing job — flats, bars, tubing, blocks a foot thick, stacked sheets, etc.

Just thread the DO-ALL with the proper band saw and you have ready for instant use Today's Fastest Machining Method—Meets the Challenge for Greater Production.

Six models — built for greater speed and a smoother finish — priced from $1,000 to $5,000 with motors.

Everyone interested in advanced shape cutting methods, should see the 265-page DO-ALL Handbook giving details about this amazing machine. Free copy on request.





CONTINENTAL MACHINES, In

1317 S. Washington Ave., Minneapolis 4, Min

DO-ALL Offices in 25 cities, with a staff of trained engineers to g you quick service on Contour Machines, Band Saws and Files, Ga Blocks and Surface Grinders.

"NOTHING" had to be Invented

Modern mathematical computations would be impossible without the symbol **O**, which permits us to indicate the position and hence the value of a digit. Mankind very early learned to make marks representing various numbers, but the concept of a mark to represent nothing at all—actually, an empty column in the counting frame—was a daring departure which opened a whole new world. To the vision and initiative of an unnamed Hindu, circa 100 B. C. we thus owe the ability to achieve present day engineering wonders.

Obviously the huge presses that Clearing designs and builds would be physical impossibilities without the assistance of exact mathematical reckoning. And today, as always, vision and initiative are still vital counterparts of constant progress.

That the men who build Clearing presses possess these qualities is evident by the presses they have built. Often it has been a Clearing Press that has provided the way for a faster and better production method. Therefore when you face a production problem that can or might be solved by a press, may we suggest that you come to Clearing.

CLEARING MACHINE CORPORATION
6499 W. 65th St. • Chicago, Illinois

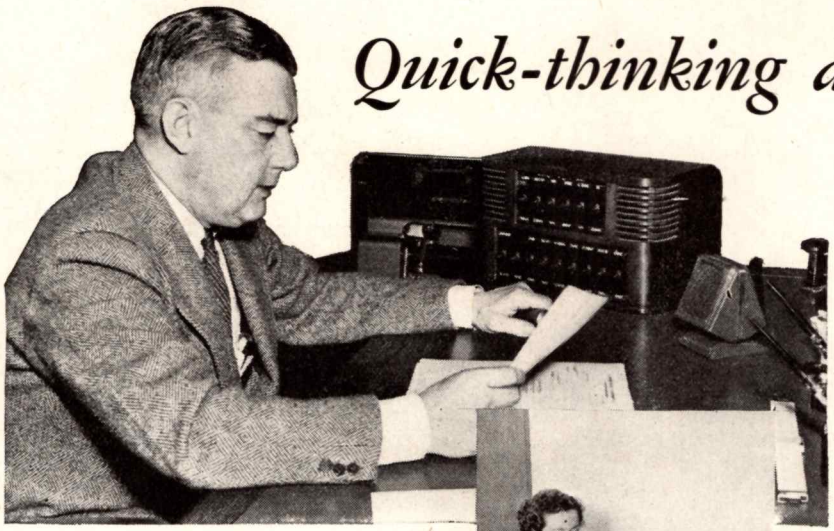
CMC CLEARING

CLEARING

CLEARING PRESSES

MECHANICAL AND HYDRAULIC

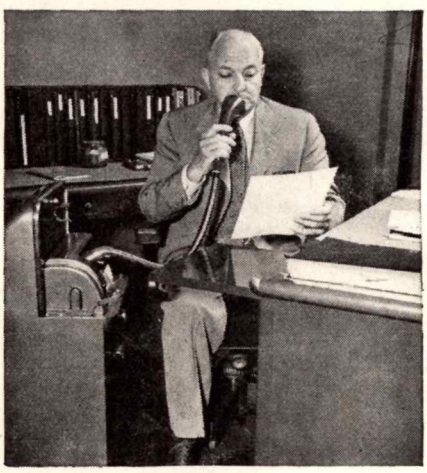
Quick-thinking and fast action at



Dictaphone streamlines thinking
Burdette S. Wright, Vice President in Charge Airplane Division.

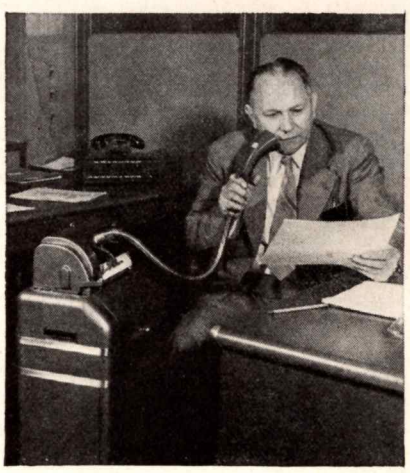
Secretaries like the Dictaphone method
Vivian Bowes, secretary to Mr. Burdette.

. . . saves lost motion
William Davey, General Manager of the Buffalo Plants.



. . . records case histories
R. H. Puffer, Personnel Manager.

. . . prevents misunderstandings
James F. Knudson, Production Manager.

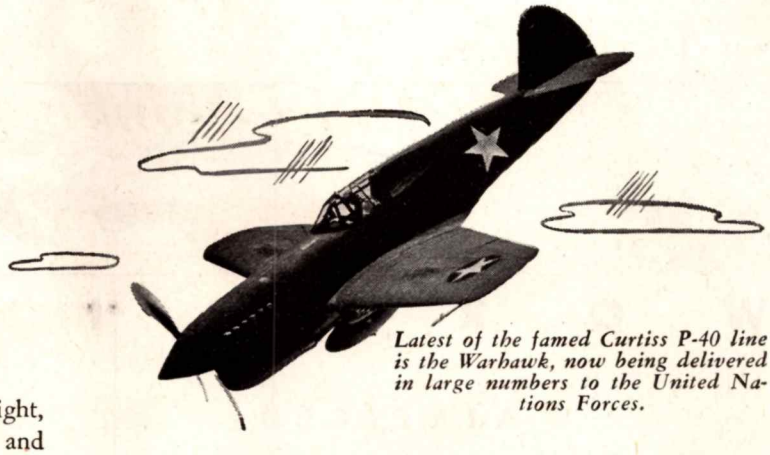


. . . for written instructions
E. F. Drollinger, Factory Manager, Plant No. 2.

. . . greatest time-saver
Clark L. Shabino, an Assistant to the General Manager.

. . . helps keep details straight
L. W. Smead, Assistant Manager of Production Planning, Plant No. 2.

CURTISS WRIGHT



Latest of the famed Curtiss P-40 line is the Warhawk, now being delivered in large numbers to the United Nations Forces.

TO many key executives at Curtiss-Wright, Dictaphone is like a right arm, indispensable and always ready for use.

During those critical months since the President's call for 185,000 war planes, every day has seen enormous quantities of production planning met and mastered by Curtiss-Wright officials. The thinking and planning incidental to an increase of personnel from a few thousand to a number equaling the population of Salt Lake City is in itself formidable.

Add vast plant developments, procurement and allocation of materials, and other production detail, and the result is a staggering burden of contact and follow-up.

The Curtiss-Wright Airplane Division executives pictured here are able to do all this smoothly, consecutively, at their own convenience because Dictaphone dictating machines are always available. The secretary is free to carry on her own work and protect the executive against needless interruptions. She doesn't have to leave her desk every few minutes to take a note or instruction.

Even after the secretary goes home, the executive is able to keep right on, if he wishes. Ideas, memos, letters, instructions, reports . . . all are on record as fast as he can speak them. Many Dictaphones are used to record important phone calls and conferences. These modern dictating machines are readily portable and hence easily taken home or used while traveling.

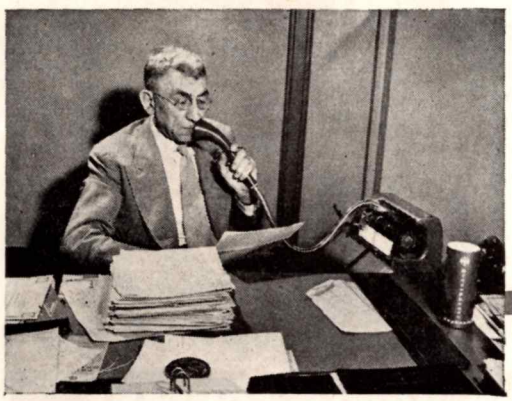
The Dictaphone method is quickly adaptable to any type of organization. It saves time and effort all down the line. For further information, call your local Dictaphone office, or write or wire us direct.

Dictaphone Corporation, 420 Lexington Avenue, New York 17, N. Y.

Left: Military Contracts Office, Airplane Division. Contract Coordinator Henry A. Lytle (right) and Ass't Coordinator Robert L. Wilson (left) are both Dictaphone users.

•

Right: Central Transcribing Department of Plant No. 1 in Buffalo. Here cylinders are speedily transcribed.

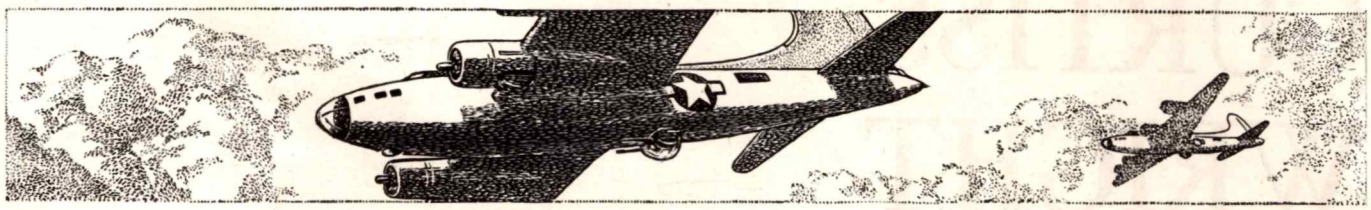


. . . larger volumes of work
F. O. Blomquist, Office Manager.

DICTAPHONE

DICTATING AND RECORDING EQUIPMENT

The word DICTAPHONE is the registered trade-mark of Dictaphone Corporation, makers of dictating machines and other sound recording and reproducing equipment bearing said trade-mark.



WORTHINGTON

AIRFIELD "GRASS BLITZER"

The vital "GROUND CREW" for today's huge airports

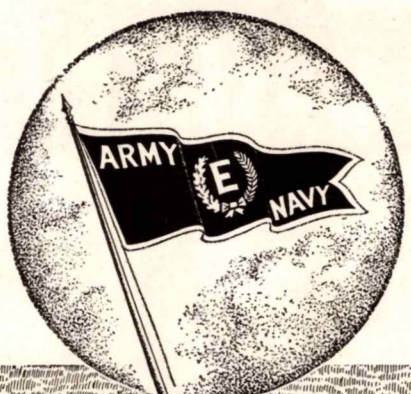
Just as bombers and fighters are kept in fighting trim by airforce mechanics, today's huge airports must also be carefully tended by their "ground crews"... to keep them fit..."to keep 'em flying." Turf cut regularly—experts advise 10 to 15 times a season depending upon the climate—assures the best take-off and landing conditions ... because dense, thick turf:

- **Keeps down dust which is a cause of too frequent motor tear-downs and plane parts replacement.**
- **Absorbs rainfall, preventing muddy areas and the danger of serious skids.**
- **Helps eliminate hazards of loose stone, gravel, etc., injuring propellers during motor revups, take-offs and landings.**
- **Assists in the control of soil erosion on these large treeless areas.**

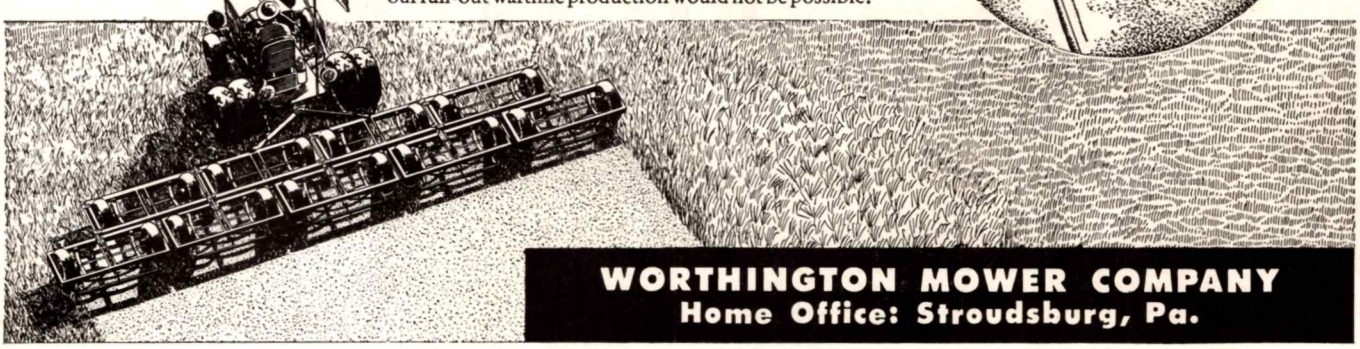
WORTHINGTON, backed by 30 years' experience in turf mowing and maintenance, developed the "Grass Blitzer" . . . a revolutionary type of mower consisting of a high speed tractor pulling a 9-gang unit cutting a swath 21.2 feet wide . . . a mower that meets today's demand for speed and maximum acreage cut per day. These figures speak for themsevles:

OLD TYPE LAWN OR GOLF COURSE GANG MOWER: maximum acreage cut per 8-hour day . . . approximately 88 acres.

NEW WORTHINGTON "GRASS BLITZER": average acreage cut per 8-hour day . . . 280 acres . . . more than three times greater cutting capacity than any other combination tractor and gang mower now available.



Since July 26th the Army-Navy "E" pennant has been flying over our plant . . . a tribute from the Armed Forces to our employees, to our suppliers and to our customers without whose wholehearted cooperation our full-out wartime production would not be possible.



WORTHINGTON MOWER COMPANY
Home Office: Stroudsburg, Pa.

CARBON

. . . its part in producing

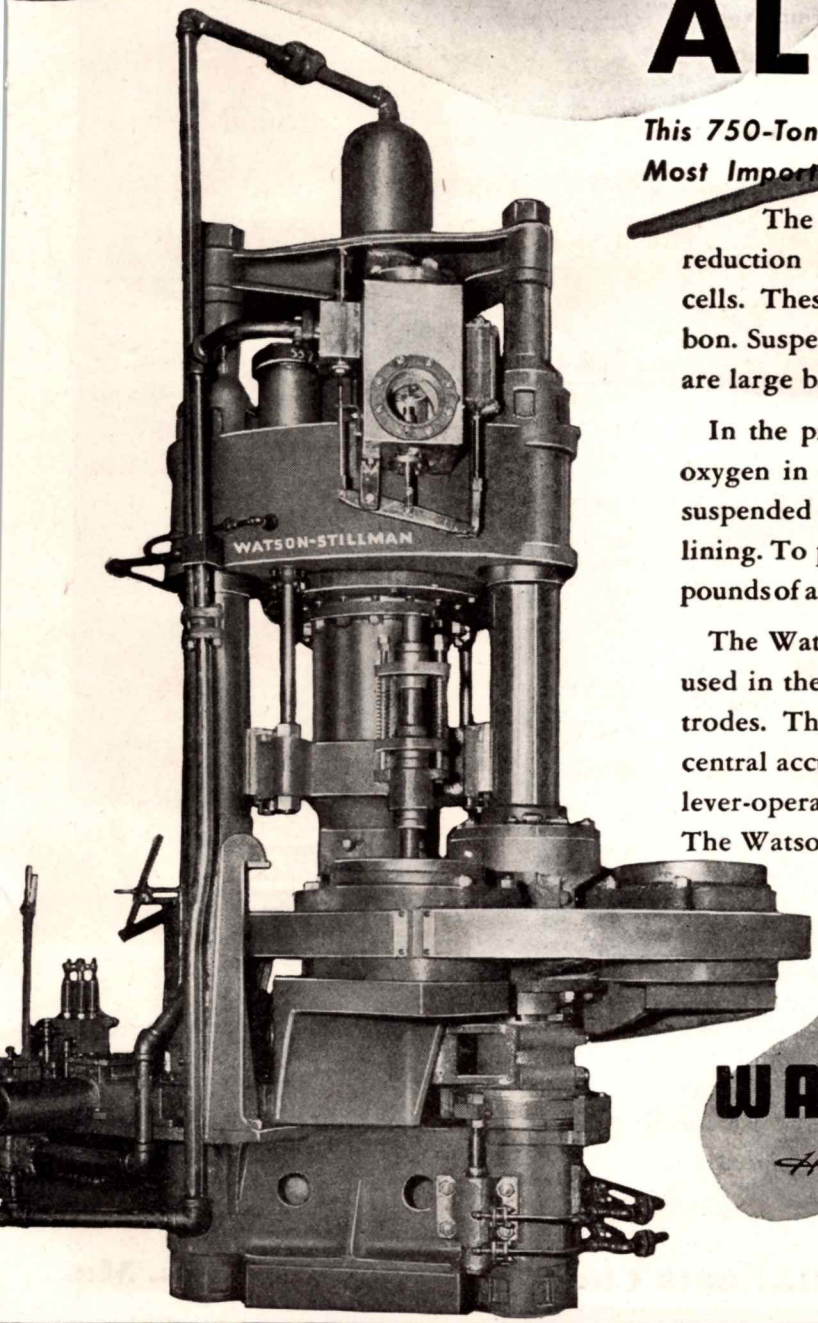
ALUMINUM

This 750-Ton Watson-Stillman Press Performs One of the Most Important Jobs in the Aluminum Reduction Plant.

The last step in the production of aluminum in the reduction plant is accomplished in large electrolytic cells. These cells are built of steel and lined with carbon. Suspended inside the cell on a bus-bar arrangement are large blocks of carbon, or electrodes.

In the process of separating the aluminum from the oxygen in the alumina, the current enters through the suspended electrodes and passes out through the carbon lining. To produce one pound of aluminum requires two pounds of alumina and three-quarters of a pound of carbon.

The Watson-Stillman 750-Ton Rotary Table Press is used in these reduction plants to mold the carbon electrodes. This machine is activated by pressure from a central accumulator station. The main control valves are lever-operated. The machine stands 18 ft. 6 in. high. The Watson-Stillman Co., Roselle, N. J.



WATSON-STILLMAN

Hydraulic Equipment, Valves
Forged Steel Fittings

For Victory ★★★ Let's all be Scrappers

In the North American B-25 "Mitchell" Bomber

PRESSTITE
EXTRUDED SEAM SEALING TAPE
Seals Riveted Fuselage Seams

Photo Courtesy North American Aviation, Inc.

North American B-25 "Mitchell" medium bombers were used by Major General Jimmy Doolittle on his Tokyo raid, and have been operated against the enemy from North Africa to the Aleutians and from New Guinea to Occupied Europe and Russia.

Fuselage seams of the B-25 are sealed with Presstite Extruded Seam Sealing Tape, as are other places where seam sealing is necessary. This Presstite sealing compound seals the fuselage against dust, dirt, rain, and air, providing cleaner, more comfortable compartments for the bomber crew.

Presstite Sealing Compounds for the aircraft industry are being used for such specialized sealing uses as the sealing of:

Integral Fuel Tanks • Drop-off, Expendable Fuel Tanks • Intercoolers and Air Ducts • De-Icer Tanks • Gun Turrets • Synthetic Glass Enclosures • Instruments • Seaplane Floats • Insulation of Dissimilar Metals

North American is only one of many leading aircraft manufacturers who rely upon Presstite products for a variety of important sealing applications.

Let Presstite help to solve your sealing problems, too. Send us detailed information as to your requirements and let our engineers recommend the Presstite products best suited to your needs. Write today.

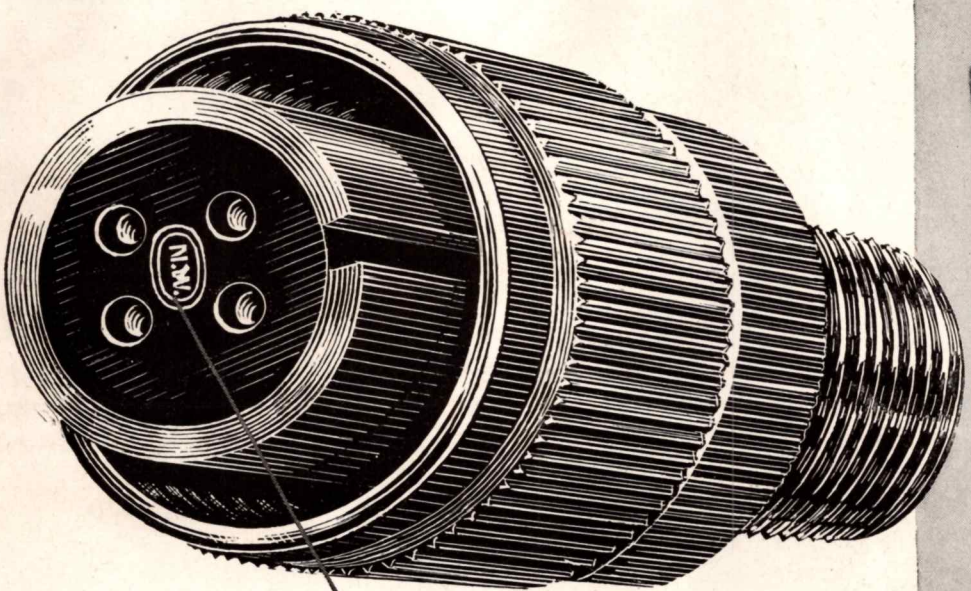
PRESSTITE
SEALING COMPOUNDS

Presstite Products for War: Aircraft Sealers, Marine Coatings and Cements, and many other Special Products for the Army and Navy.

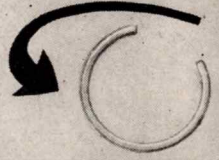
Presstite Products before Pearl Harbor: Sealers for the Refrigeration Industry, Railroads, Industrial Plants, Sewer Construction.

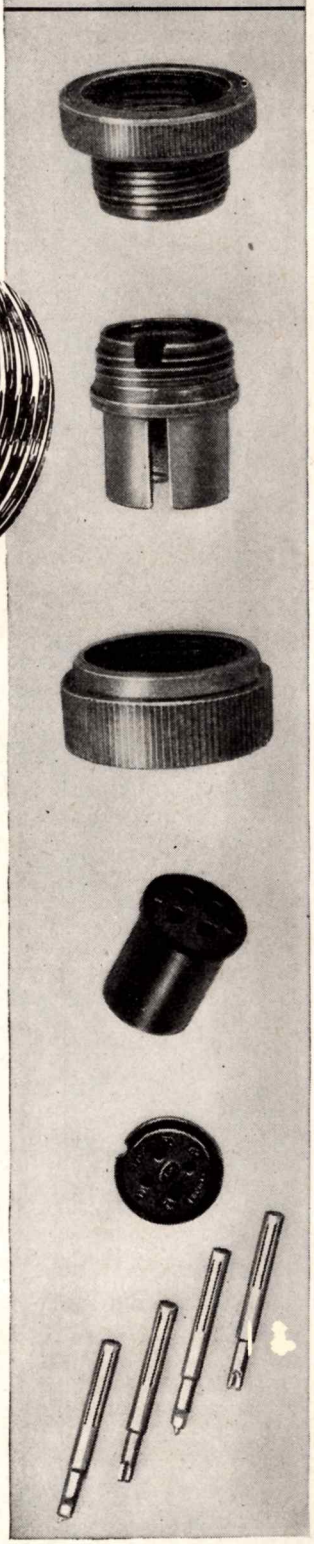
PRESSTITE ENGINEERING CO., 3912 Chouteau Ave., St. Louis, Mo.

We make AN Connector Plugs from tool design to finished products



With the exception of this tiny part WE MAKE THE ENTIRE PLUG





If deliveries are slowing your production perhaps we can help. For there is much less chance of a bottleneck when you order plugs from a manufacturer who makes (with the exception of one tiny part) the entire plug.

Being *the only completely, self-contained plant in the country,* when we make a promise we are in a better-than-usual position to keep it because we do the engineering, designing, tool-making, die-casting, insulator-molding, machining and assembling.

If desired, we are equipped to give each aluminum die-cast part the diachromatic finish. Our production now runs to many thousands of AN Connector and Signal Corps Plugs per day. Our manufacturing technique has been developed to a degree where product perfection is virtually assured.

Our production of connector plugs is not purely a wartime effort. We are building for the peace, too. That's why we have a large engineering staff working constantly on the further improvement and development of electrical connectors.

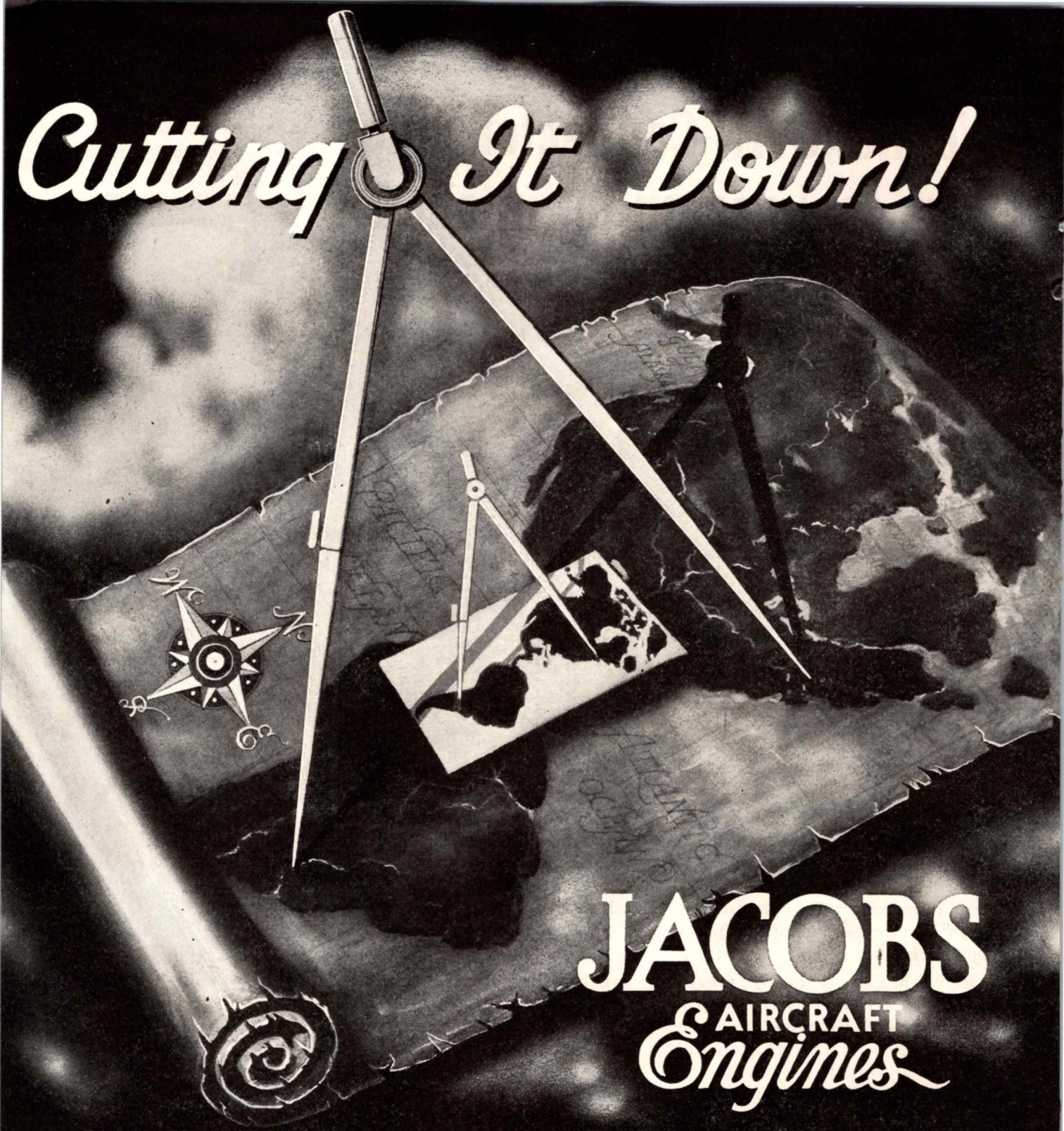
We urge you to visit our factory and examine our facilities with an eye to their being utilized for the purpose of increasing your production and thus stepping up the flow of completed equipment to our armed forces.

Write, wire or telephone . . .

NORTHAM WARREN CORPORATION

War Works Division

STAMFORD, CONNECTICUT



The old map is rapidly being cut down—distances are being reduced from days or weeks to hours.

The countries of Latin America, once our distant friends, are truly becoming our next-door neighbors. Inter-American travel will grow by leaps and bounds after the war. The vacationist will be able to swim at the glorious beaches of Rio on Saturday and be back at work Monday. Round trips on business during the week will be commonplace.

Modern light Airliners, powered by efficient, dependable Jacobs Engines, will provide rapid and easy travel from the international airline terminals to the interiors of these countries, opening their unlimited resources and beauty to us all.

All this will come after the war—but how soon it will come depends on how well we do our War Job NOW.

JACOBS AIRCRAFT ENGINE CO.
POTTSTOWN, PENNSYLVANIA, U. S. A.

FLYING THEM HOME THROUGH THE WORLD'S WORST WEATHER

BOMBER crews and fighter pilots' chances of "flying them home" are limited if pulleys fail and jam the controls.

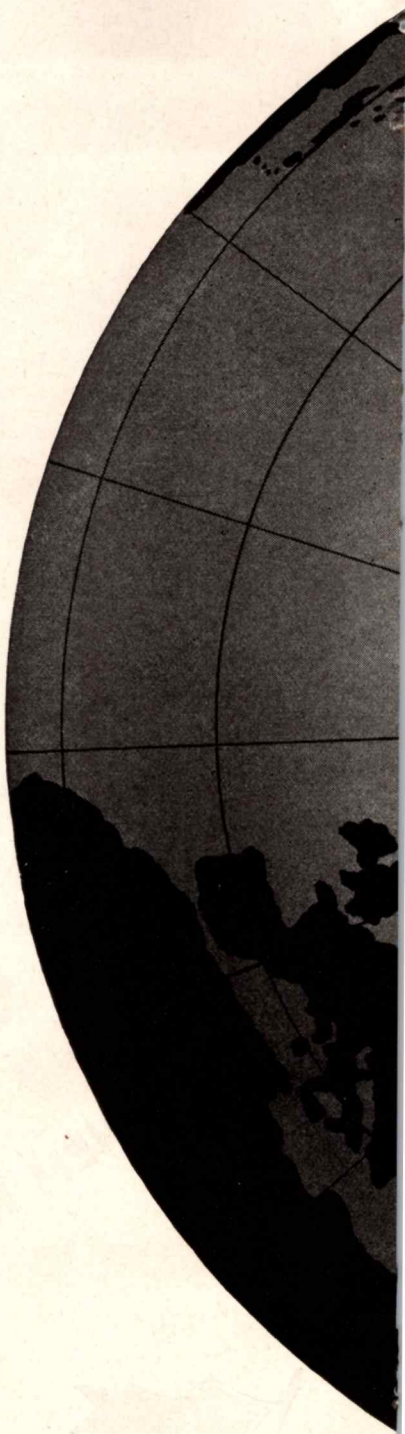
Formica control pulleys and cable fairleads are preferred parts because of their high strength to weight ratio, and ability to reduce cable wear.

Formica control pulleys are the result of good engineering and progressive production methods.

Other aircraft parts made of Formica are instrument panels, ignition breaker arms, radio coil forms, sub panels and tube bases, antenna insulators, propeller blades, guide blocks and vibration frequency change collars.

THE FORMICA INSULATION CO., 4618 SPRING GROVE AVE., CINCINNATI, O.

alternating current



Back when electric power was mostly *direct current,* towns like Plainville still burned kerosene lamps. The distribution range of direct current was too limited.

Alternating current changed that . . . Westinghouse pioneered the change-over which expanded the economic range of power lines to 300 miles and over . . . brought light and energy to every crossroad and hamlet.

Now, history is being repeated in the growth of America's bomb power. As planes increase in size, range and ceiling, more and more electric power is needed. This involves a severe weight penalty with low-voltage *direct-current* systems.

As the answer to electric power requirements on these super-bombers, Westinghouse is helping to develop a high-frequency *alternating-current* system. This system contributes to weight savings in generator and motor designs—effects further savings in distribution copper weight. With this increased power, bombers can hit harder, fly higher and farther.

* * *

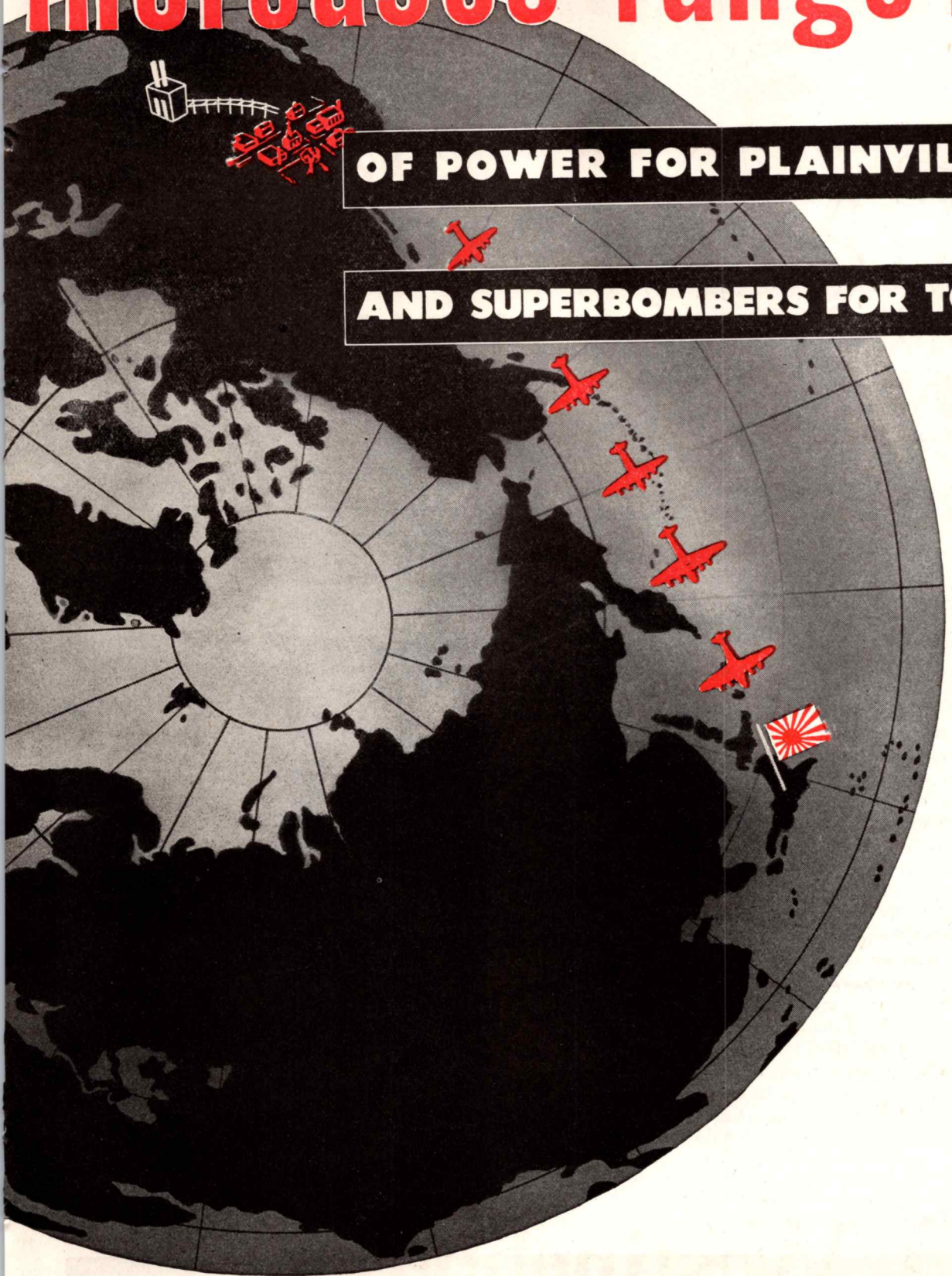
By means of an A-C Calculating Board, Westinghouse engineers are analyzing the a-c requirements of modern bombers. Actual equipment has been developed to the point where a standard line of a-c equipment for aircraft will soon be available. So, if you need help on electrical equipment for aircraft, consult Westinghouse —builders of the first successful, 3-phase, 400-cycle equipment for aircraft. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N.

J-03190

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

increases range . . .



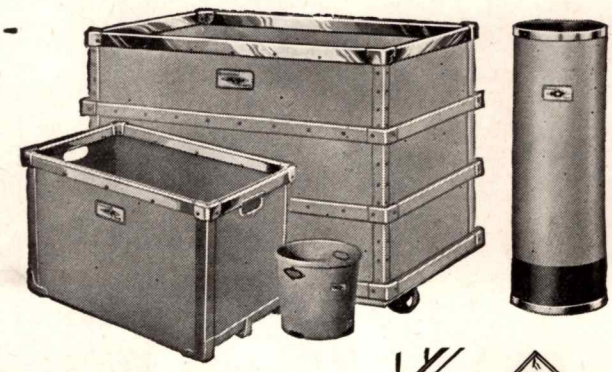
OF POWER FOR PLAINVILLE . . .

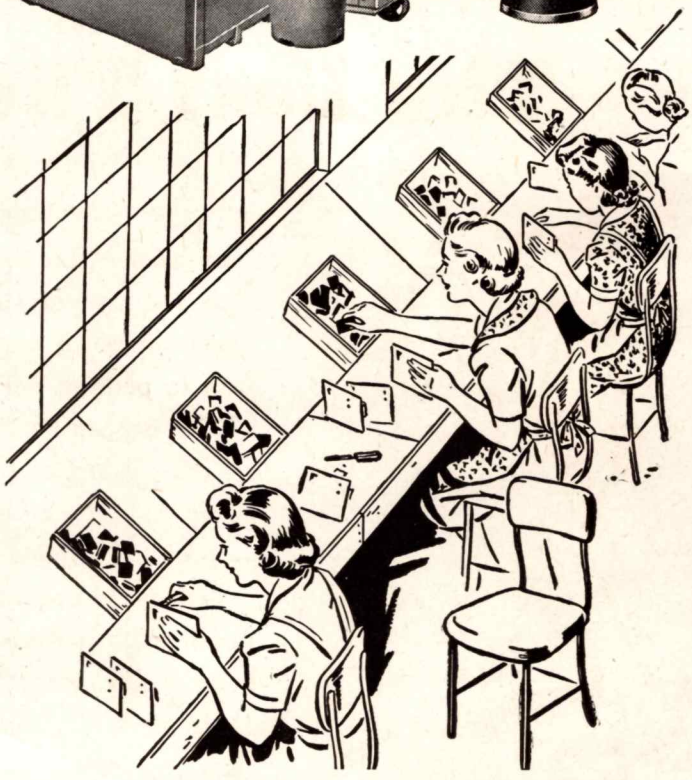
AND SUPERBOMBERS FOR TOKYO!

Pioneering A-C Equipment for Aircraft

SPLINTERS—INJURIES—INFECTION—

reduced to a minimum in material handling by a CONTINENTAL-DIAMOND Product





MANY vital war plants were suffering serious production delays due to injuries from splinters from wood trays, boxes, trucks until they changed over to DIAMOND FIBRE material handling equipment.

DIAMOND FIBRE is a tough, splinter-proof, non-shattering, non-corrosive material that is also light in weight (about half the weight of aluminum). Its use to make trays, boxes, barrels, trucks, and other handling equipment has enabled many plants to entirely eliminate serious production hold ups due to time out for first aid to splinters and other injuries from wood and metal equipment.

The light weight of DIAMOND FIBRE Hollow Ware has also been a factor favorable to increased production especially where women are employed.

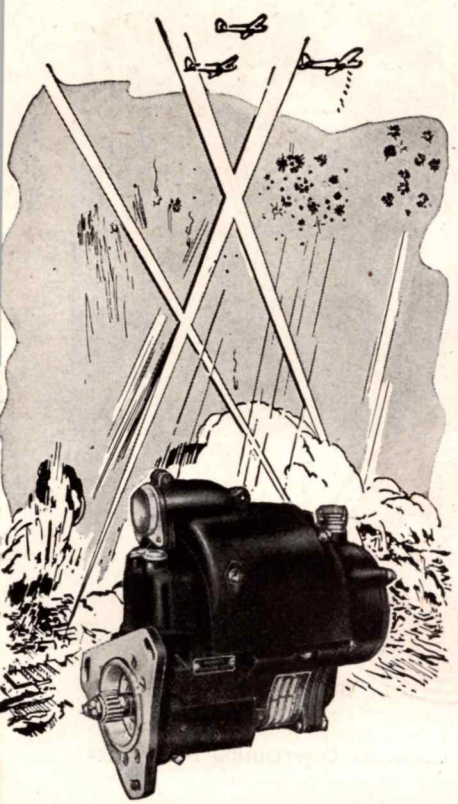
This example of another C-D contribution to the War Effort may suggest advantageous uses you can make of DIAMOND FIBRE, in material handling equipment or as a mechanical or electrical insulating and structural material. Catalog HW-3 illustrates and describes many types of DIAMOND FIBRE Hollow Ware for material handling. Catalog DF-3 tells of the many uses in every industry for DIAMOND FIBRE sheets, rods, tubes and special parts. Either or both are yours for the asking.

District Offices: New York • Cleveland • Chicago • Spartanburg, S. C.
West Coast Rep., Marwood, Ltd., San Francisco
Sales offices in principal cities

Continental-Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

The Last Thousand Feet



OUR heavy bombers and the enemy's ack-ack guns are pitted in an endless race for altitude. The last thousand feet make all the difference and present the supreme test of pilot, plane, and equipment. American Bosch magnetos were designed for that last thousand feet . . . built to perform unfailingly far higher than ever before required.

The dependable magnetos flowing from American Bosch assembly lines are the product of *modern* New England craftsmanship. American planes outfly the flak with the help of magnetos made by our *specialist* craftsmen — men and women, 20 to 60 years of age, trained for specific jobs.

The production success of these workmen results from American Bosch engineering, planning, and tooling — the same know-how that helps to get maximum power and service from engines.

In research, design, and production — war or peace — American Bosch serves all branches of the internal combustion engine industry.

AMERICAN BOSCH CORPORATION • SPRINGFIELD, MASSACHUSETTS

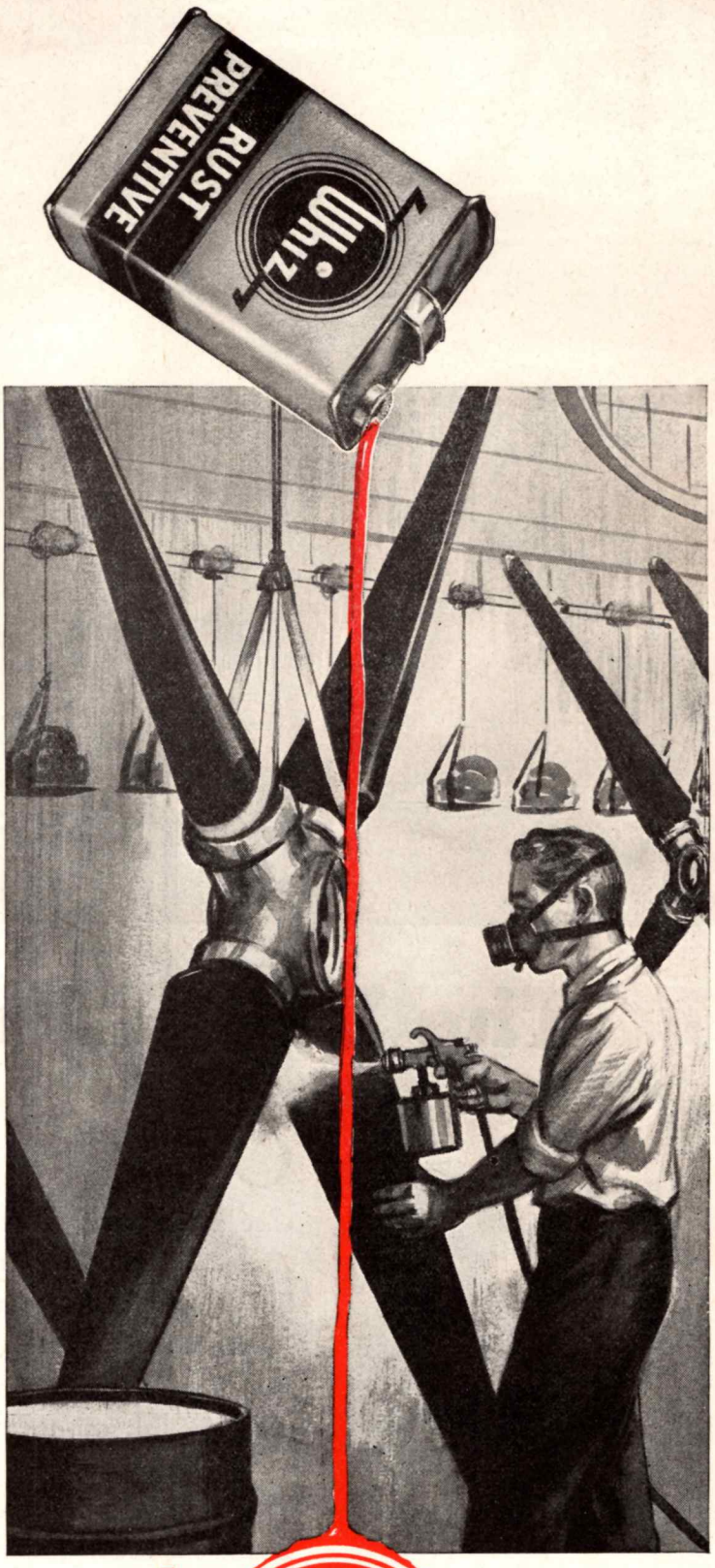
AMERICAN BOSCH

AVIATION AND AUTOMOTIVE ELECTRICAL PRODUCTS . . . FUEL INJECTION EQUIPMENT

MODERN CRAFTSMEN IN THE NEW ENGLAND TRADITION

Whiz RUST PREVENTIVES

. . . the *"liquid packaging"* that gives protection to airplane parts from Factory, to Assembly Line, to Battlefront . . . .



R. M. Hollingshead Corporation manufactures a complete line of rust and corrosion preventive compounds that meet fully Government specifications. There are WHIZ compounds for the protection of both internal and external surfaces.

Depending upon the type, this "liquid packaging" is applied to plane parts and weapons by spraying, swabbing, brushing, or dipping. Eliminating the risk of rust and corrosion from the time the parts leave the factory until they go into action, these WHIZ compounds are easily and quickly removed when war material reaches its destination—saving time when minutes are precious.

As a major supplier of maintenance chemicals for Army and Navy aircraft, we welcome your inquiries about these protective compounds. Our engineers are ready to work directly with your engineers in designing a chemical product to meet your special requirements. *R. M. Hollingshead Corp., Camden, New Jersey; Toronto, Canada.*

WHIZ RUST PREVENTIVE COMPOUNDS
(Thin Film, Polar Type)

WHIZ AIRCRAFT PRESERVATIVE COMPOUND
(Paralketone Type)

WHIZ RUST PREVENTIVE COMPOUND
(Paralketone Type)

WHIZ CORROSION PREVENTIVE COMPOUND
(For Aircraft Engines and Parts)

AND OTHER SPECIAL COMPOUNDS

Hollingshead

LEADER IN MAINTENANCE MATERIALS

Whiz

BUY MORE BONDS!

ALSO MAKERS OF WHIZ HYDRAULIC FLUIDS, COMPOUNDED LUBRICANTS, LUBRICATING OILS, AND CLEANING COMPOUNDS FOR AIRCRAFT

YOU CAN'T LOOK TWICE

Going 6 miles per minute!

Instant Legibility Assured With ROXALIN Finished Instruments

A small, but vitally important item on most combat equipment, is the instrument dial from which split second readings must be made.

The permanent retention of balanced contrast between small black figures on a non-reflective white background is now possible through the use of Roxalin DIAL WHITE* which overcomes the weakness of conventional materials formerly used for this purpose.

Roxalin DIAL WHITE will not discolor on aging, is unaffected by sudden temperature changes, and retains its clean white tone even after long exposure to chemical fumes frequently encountered in molded plastic housings.

It is easily applied in production by spraying or roller coating, sets up to handle in lacquer time or may be forced dried if desired.

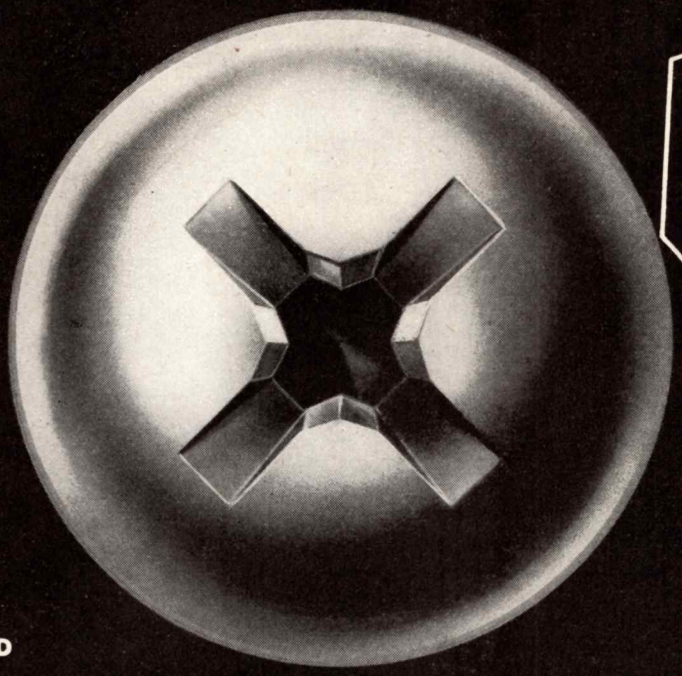
Write for complete information.

***Another coating of plastic by Roxalin.**

ROXALIN *Flexible* FINISHES
INCORPORATED
ELIZABETH, F, NEW JERSEY

WATCH ROXALIN IN AVIATION

IT MUST BE RIGHT!



21 Leading Makers of Screws recommend the PHILLIPS RECESSED HEAD

WOOD

MACHINE

SELF-TAPPING

STOVE

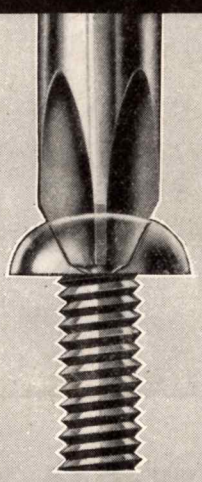
21 Concerns Offer the Phillips Head

AMERICAN SCREW CO. . . . . . *Providence, R. I.*
THE BRISTOL CO. . . . . . *Waterbury, Conn.*
CENTRAL SCREW CO. . . . . . *Chicago, Ill.*
CHANDLER PRODUCTS CORP. . . . . . *Cleveland, Ohio*
CONTINENTAL SCREW CO. . . . . . *New Bedford, Mass.*
THE CORBIN SCREW CORP. . . . . . *New Britain, Conn.*
THE H. M. HARPER CO. . . . . . *Chicago, Ill.*
INTERNATIONAL SCREW CO. . . . . . *Detroit, Mich.*
THE LAMSON & SESSIONS CO. . . . . . *Cleveland, Ohio*
THE NATIONAL SCREW & MFG. CO. . . . . . *Cleveland, Ohio*
NEW ENGLAND SCREW CO. . . . . . *Keene, N. H.*
THE CHARLES PARKER CO. . . . . . *Meriden, Conn.*
PARKER-KALON CORP. . . . . . *New York, N. Y.*
PAWTUCKET SCREW CO. . . . . . *Pawtucket, R. I.*
PHEOLL MANUFACTURING CO. . . . . . *Chicago, Ill.*
READING SCREW CO. . . . . . *Norristown, Pa.*
RUSSELL BURDSALL & WARD BOLT & NUT CO. . . . . *Port Chester, N. Y.*
SCOVILL MANUFACTURING CO. . . . . . *Waterville, Conn.*
SHAKEPROOF INC. . . . . . *Chicago, Ill.*
THE SOUTHINGTON HARDWARE MFG. CO. . . . . . *Southington, Conn.*
WHITNEY SCREW CORP. . . . . . *Nashua, N. H.*

Out of the many screw heads designed through the years to eliminate screw driving troubles, *only* ONE has gained wide approval by the men who should know most about screws... the men who develop and produce fastening devices.

It is highly significant that the leaders in the screw industry . . . *21 concerns* . . . recommend the PHILLIPS RECESSED HEAD as the first recessed head that is *right* in every respect! It assures you that screw driving troubles will be ended when you specify PHILLIPS. Also, it means convenience in buying, and prompt and capable service.

PHILLIPS *Recessed Head* SCREWS



KEY TO FASTENING SPEED AND ECONOMY

The Phillips Recessed Head was scientifically engineered to afford:

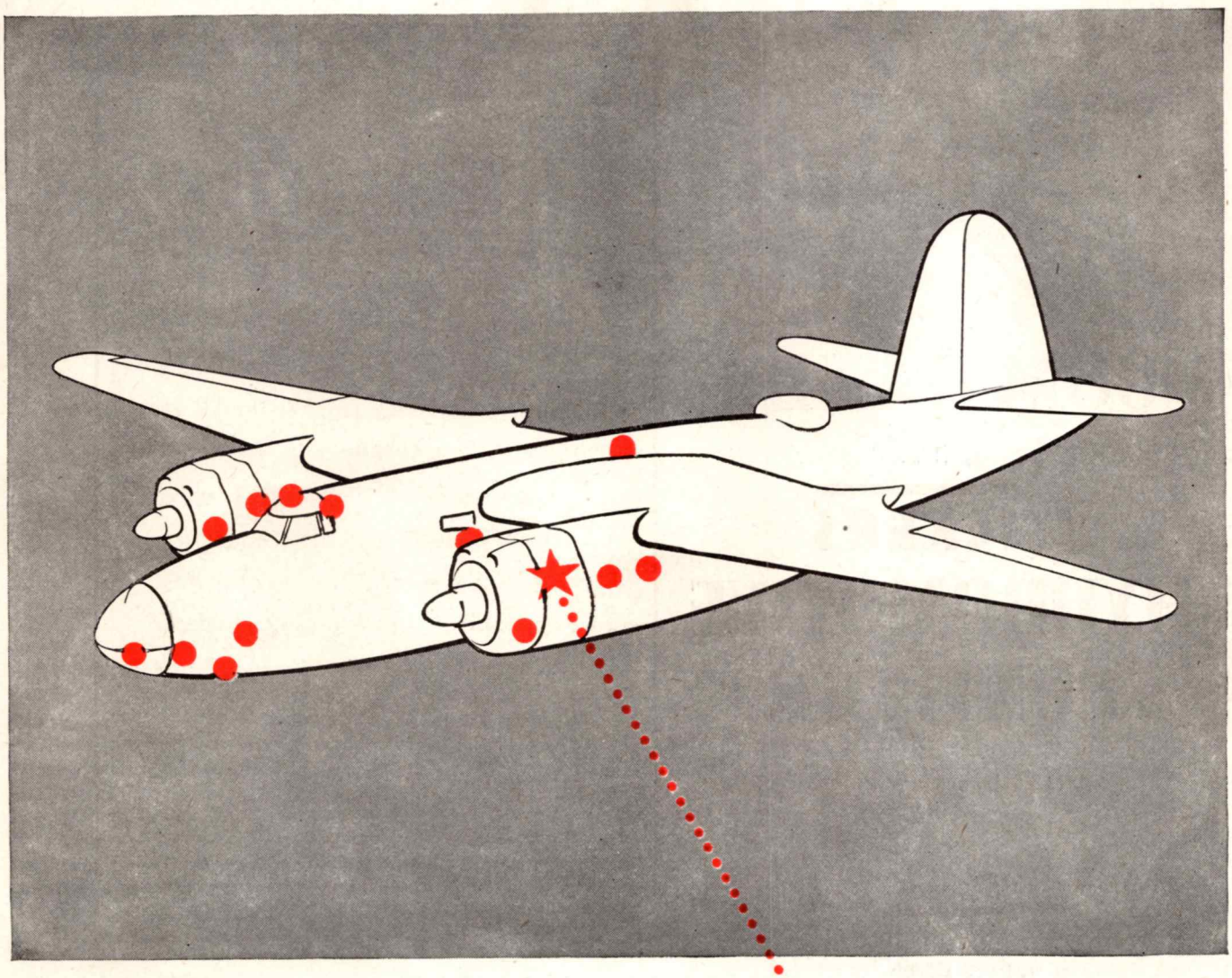
Fast Starting – Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving – Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS



Hydraulics on the Job!

Performing a score of vital functions in one of our deadliest bombers

A newcomer to the aviation field, The Maytag Company, Newton, Iowa, is producing many types of Hydraulic Cylinders* for famous combat planes. Producing them to a design created by Maytag engineers on basic principles which offer many advantages of simplification, thorough dependability and ease of servicing.

Maytag Hydraulic Cylinders are simple and rugged, have a minimum number of parts, require no delicate adjustments. They do their jobs with unfailing dependability in the scorching heat of the desert or the intense cold of the arctic.

Yes, "Maytag's in Aviation"... and will be for a long time to come. As time goes on, we believe you'll hear more and more ... all to the good ... about Maytag Hydraulic Cylinders.
THE MAYTAG COMPANY, NEWTON, IOWA

Maytag

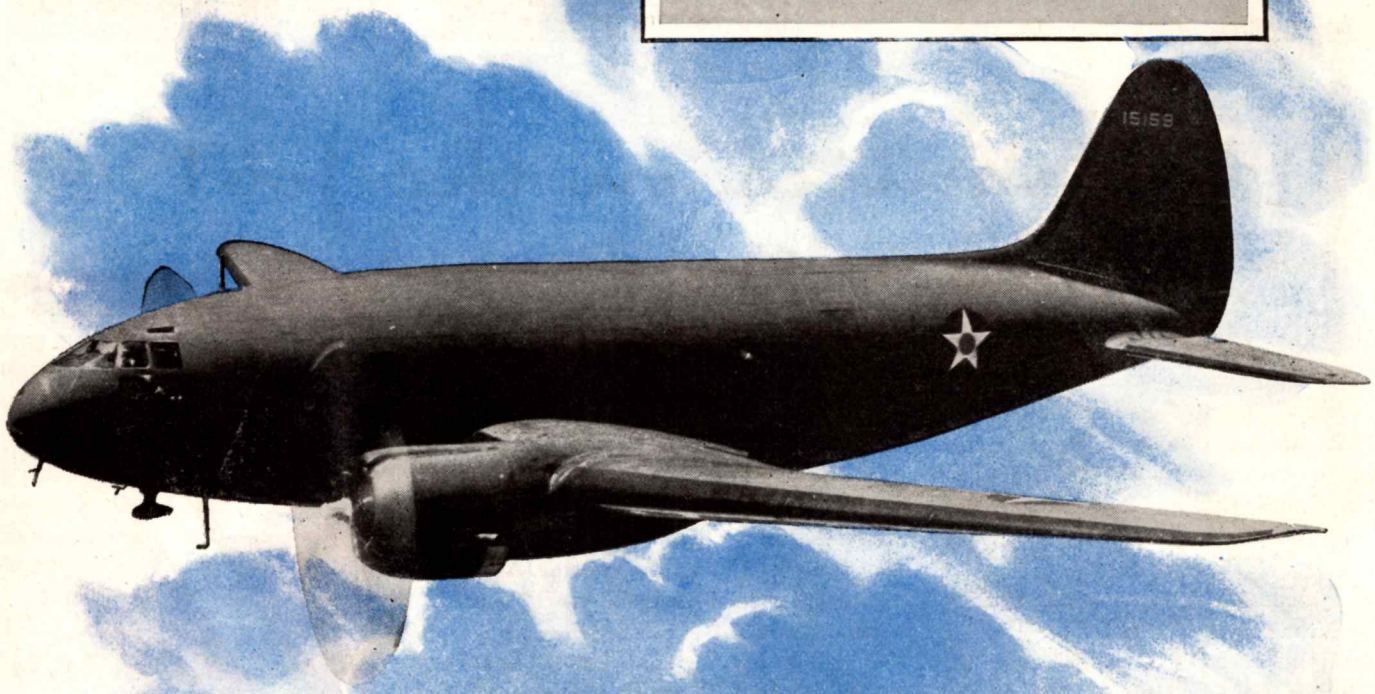
*Maytag also produces Eclipse electric retracting units . . . alumnium alloy aircraft castings.

Curtiss COMMANDO uses VICKERS HYDROMOTIVE CONTROLS

VICKERS Hydraulic Equipment is used on many of the most modern airplanes. The Curtiss "Commando" Cargo-Transport illustrated here is representative.

Vickers Hydraulic Controls are high pressure oil hydraulic controls that are so widely used because they do the job dependably, smoothly and accurately . . . no matter how severe the service. They are insensitive to shock and vibration yet light in weight . . . easy to adjust . . . admirably suited to aircraft needs.

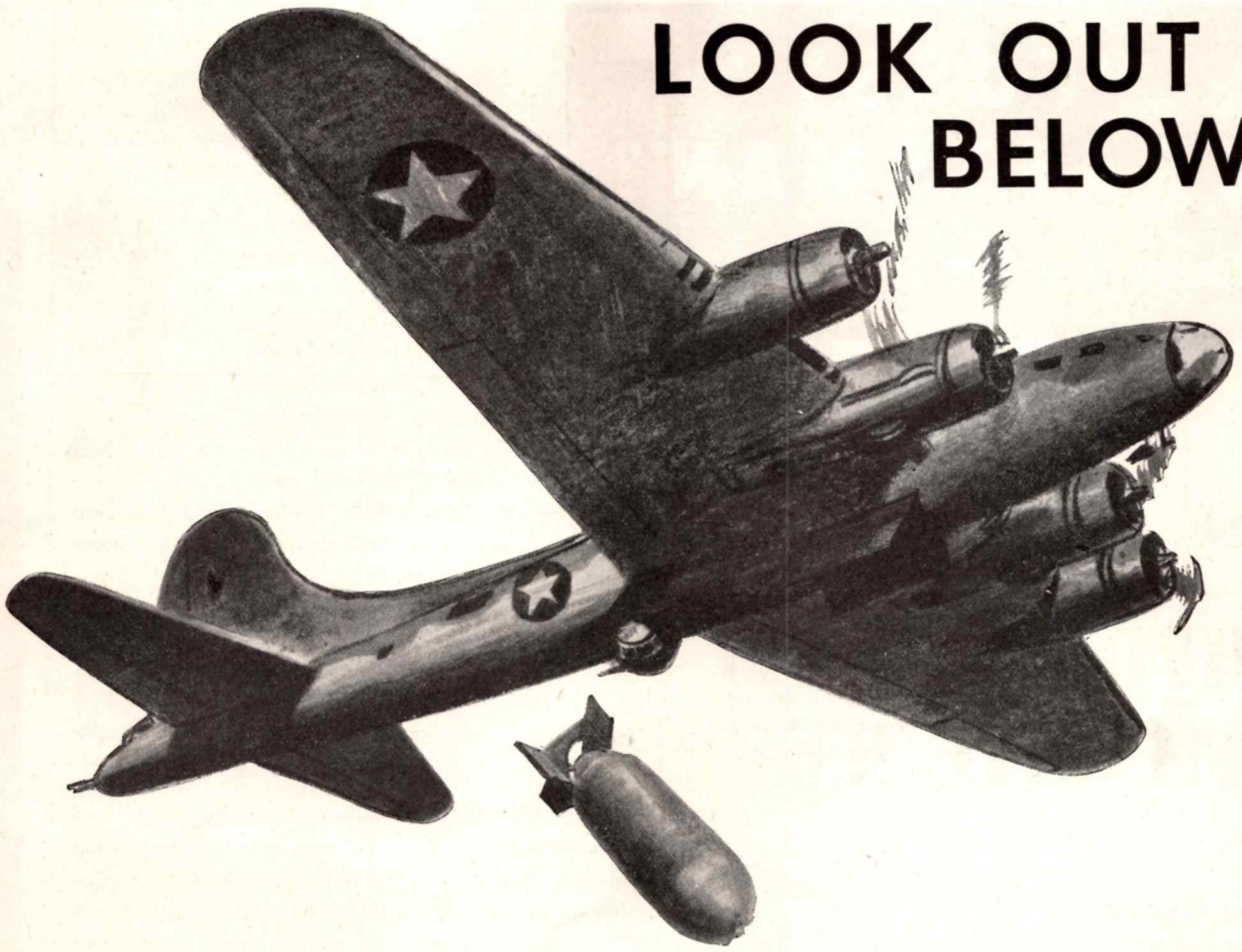
VICKERS
Incorporated
1458 OAKMAN BLVD.
DETROIT, MICHIGAN



ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

OFFICIAL PHOTOGRAPH, U. S. ARMY AIR FORCES

LOOK OUT BELOW!



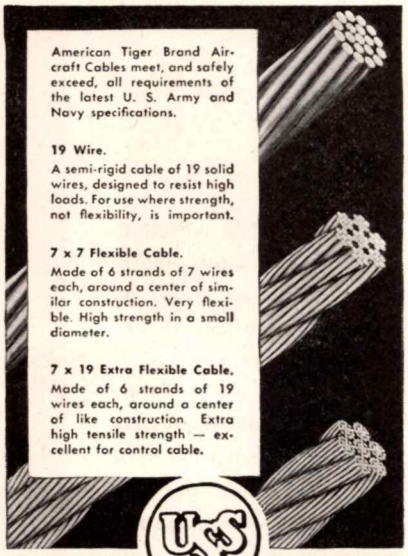
—Here comes a wallop "right on the button"

DESIGNED to do the seemingly impossible—to proceed to a distant target *alone*, and to hit one ship, one dock or one particular part of a war plant from extreme heights—that's the Flying Fortress, the plane that has made precision bombing a daytime nightmare for the Axis.

Superior control is the very basis of precision bombing. Without it, the Fortress' effectiveness for spot bombing would be seriously diminished. The fact that American Tiger Brand Control Cables are used in this famous plane speaks for itself as recognition of superiority.

In America's finest combat and commercial aircraft, Tiger Brand Control Cables translate the hair-trigger decisions of the pilot into direct, instantaneous action. Their high strength and high fatigue resistance, minimum stretch and superior flexibility insure the sensitive response indispensable for precision flying and combat tactics. The fact that they are of Excellay Preformed construction is further assurance of flawless performance.

Call on our aircraft cable engineers when changing specifications and new designs confront you with problems. They have an understanding of your needs that you will find helpful.



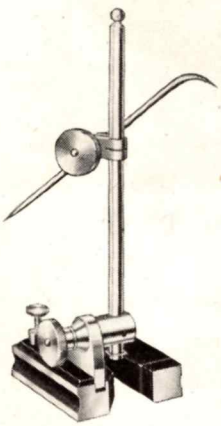
AMERICAN
Tiger Brand
CONTROL CABLES

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York

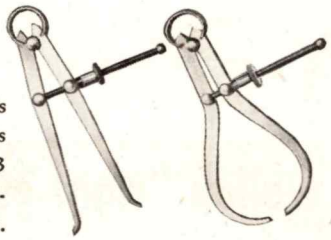
UNITED STATES STEEL

"FUSSY" CRAFTSMAN?

These are the tools for you!

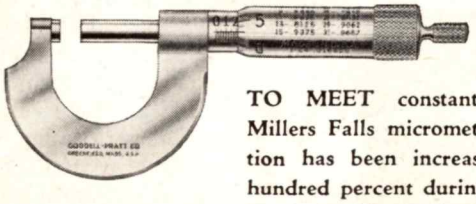


THOUGH moderately priced, Millers Falls surface gauges are well-made, well-finished, and unusually versatile. Base is ground for use on flat surface plate and grooved for cylinder. Scriber is spring-held in position as thumb nut is tightened . . . a big help for quick, accurate settings. Spindle can be used as depth or scratch gauge. Many other features for accuracy and convenience demonstrate this tool's background of skill and long experience.

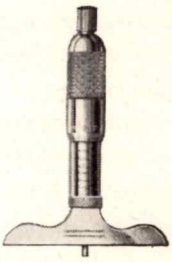


THERE ARE 64 kinds and sizes of Millers Falls calipers and dividers — 3 to 12 inches, inside, outside, and hermaphrodite. All are designed to meet the most exacting requirements of skilled machinists and toolmakers. Made of crucible steel, with rounded edges, hardened, ground, and polished. Many features for accuracy, rigidity, and convenience.

Millers Falls' 75 years of toolmaking "know-how" shows in these *quality* tools.

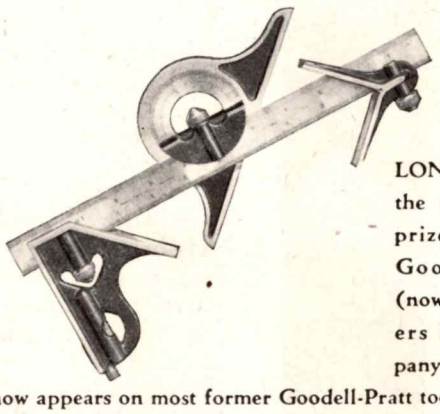


TO MEET constant demand, Millers Falls micrometer production has been increased several hundred percent during this war. Typical Millers Falls quality, these are high-precision tools; now used largely in the manufacture and repair of war goods, they'll also be needed in huge quantities for production and maintenance in the mechanized world of tomorrow. Plan now to "tool up" with Millers Falls *quality* micrometers.



DESIGNED to make accurate depth measurements of holes, slots, shoulders, and projections, the Millers Falls Micrometer Depth Gauge is a rugged, precise shop tool. Spindle movement one inch, capacity 0 to 3" by .001"; capacity may be increased up to 12 inches with Millers Falls hardened and precision-ground extension rods. Several special features insure accuracy and long wear.

FOR CRAFTSMEN who want to *know* their work is accurate, Millers Falls makes an interesting line of precision tools including 14 sizes and styles of steel rules and slide calipers—light, semi-flexible, flexible, and narrow. They're all of carefully heat-treated crucible steel, ground and polished, and graduated with precision by dividing engines developed and perfected by our own engineers over a period of forty-odd years. Accuracy guaranteed.



LONG AMONG the most highly-prized items of Goodell-Pratt (now part of Millers Falls Company, whose name now appears on most former Goodell-Pratt tools) has been this Combination Set—blade, beam, protractor, and center head—the most useful precision tool ever made for machinists and toolmakers. Accurate No. 4 graduation; all working faces precision ground; tempered crucible steel blade; complete with level and scriber.

MILLERS FALLS TOOLS

SINCE 1868

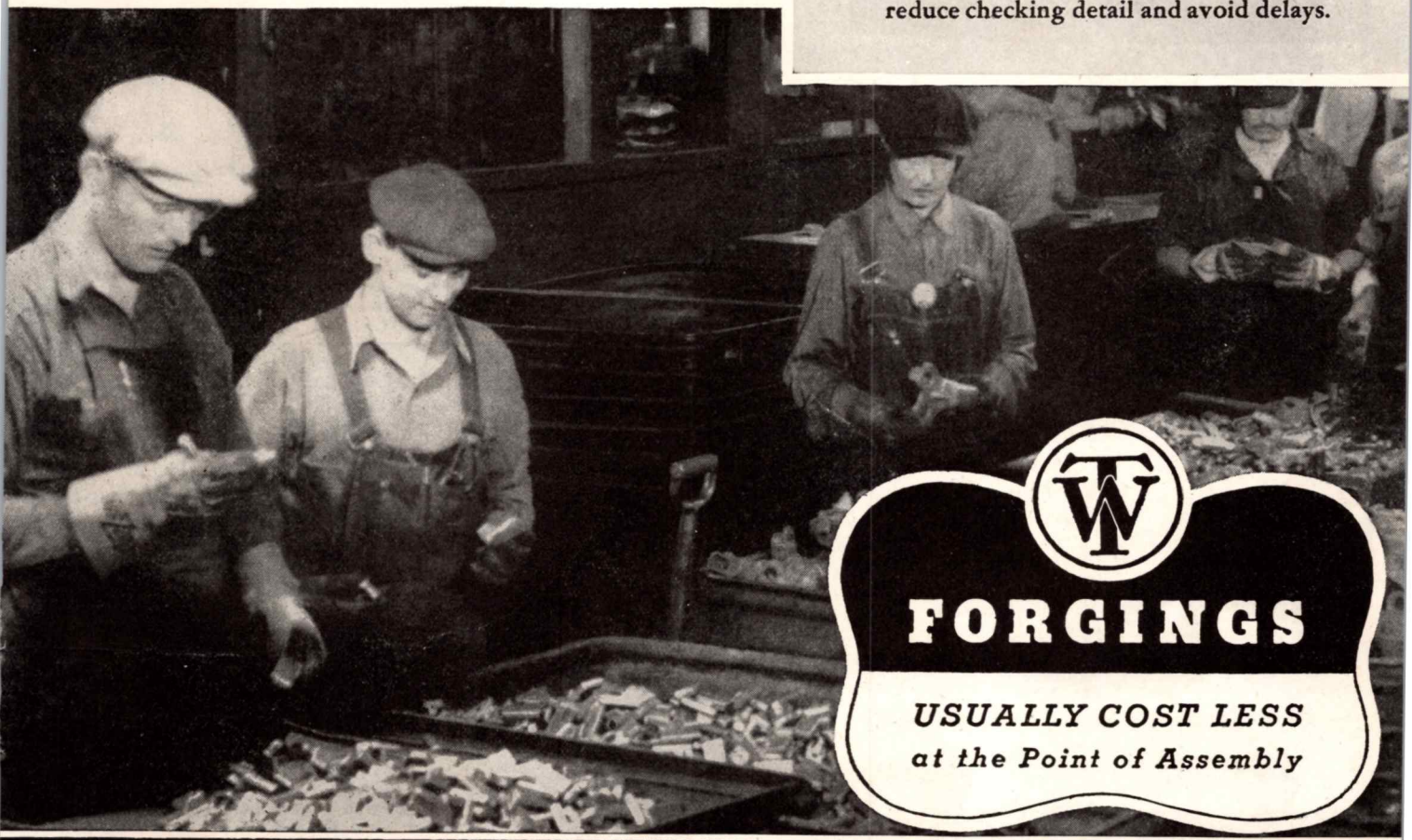
MILLERS FALLS COMPANY GREENFIELD, MASSACHUSETTS

Pre-Inspected Forgings Reach the Assembly Line Sooner!

Pre-inspected forgings should reduce checking detail and avoid delays. But without confidence in the merit of forgings produced by a particular supplier, this cannot be so. When inspectors within your own plant repeatedly check ten and pass ten T & W Forgings, that builds confidence in T & W inspectors. It substantiates the claim that T & W inspectors are paid by us to lessen the time it takes for T & W Forgings to get onto your assembly line.

Conducting a close visual and technical inspection of forgings, involving the use of modern mechanical devices, T & W inspectors spot forgings which fail to meet the usual T & W standard. T & W inspectors are responsible direct to management itself. Such pre-inspection protects you from receiving forgings that might involve a waste of materials or a waste of time in finishing forgings. Ask a T & W Forging Engineer about gaining time through the use of pre-inspected forgings.

Steel for T & W Forgings is given a thorough laboratory inspection before it ever reaches the heating furnaces and forging hammers. Using quality material, working in accordance with fixed standards controlling the uniformity of physical structure and the size, shape and surface finish of forgings, T & W forging craftsmen produce forgings that reduce checking detail and avoid delays.



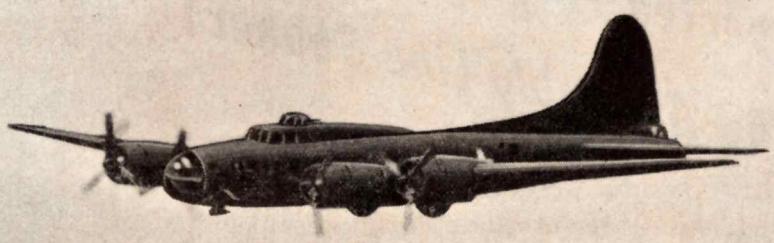
FORGINGS

USUALLY COST LESS at the Point of Assembly

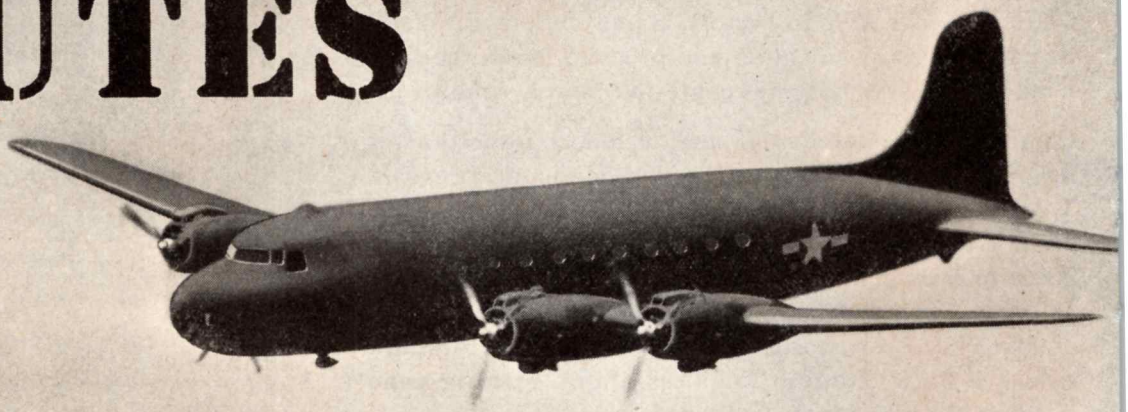
TRANSUE & WILLIAMS

STEEL FORGING CORPORATION • ALLIANCE, O.

SALES OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, INDIANAPOLIS, DETROIT AND CLEVELAND



BIG BRUTES



Douglas builds all three

When United Nations air strategy called for concentration on heavy bombers and transports, only Douglas was chosen to produce all three current 4-engine types: Douglas' own C-54 Skymaster Combat Transport (center), the B-17 Flying Fortress (top) and the B-24 Liberator Bomber. Douglas production of these "big brutes" has been on schedule or ahead of schedule, in addition to fabulous output of more other types of aircraft than any other manufacturer.

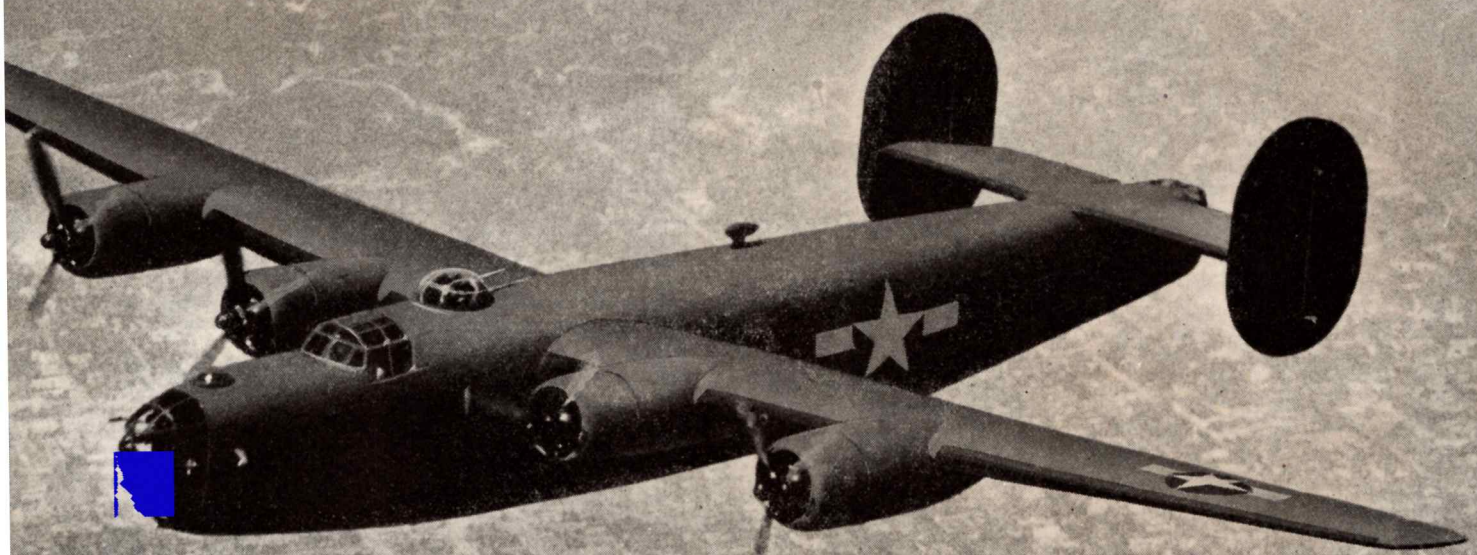
DOUGLAS

DOUGLAS AIRCRAFT CO., Santa Monica, Calif.

LONG BEACH, CALIF. EL SEGUNDO, CALIF.
TULSA, OKLAHOMA OKLAHOMA CITY CHICAGO

3rd WAR LOAN

BACK THE ATTACK—WITH WAR BONDS



WRIGHT POWERS THE TONNAGE OF THE AIR

A Cross Section of Aviation History

1903 The 12 H.P. engine in the Wright brothers' first plane was a product of their own ingenuity, built after many existing types had been considered and rejected.

1918 The 150 H.P. Wright Hispano Suiza, mass-produced for World War I, which introduced to America the art of precision aluminum casting, was redesigned to 300 H.P. before war's end.

1926 Wright developed and produced America's first radial, air-cooled engines. Byrd used early 200 H.P. Whirlwinds for his North Pole flight, and 220 H.P. models powered the numerous ocean flights which followed.

1938 Modern air transport had been inaugurated by Douglasses with 700-800 H.P. Cyclones. In a Lockheed 14 transport with 1100 H. P. Cyclones, Howard Hughes girdled the globe in 3 days, 19 hrs.

1943 World's largest transports, the Lockheed *Constellation* and the Martin Mars use 2000 H.P. Cyclones. Many outstanding military planes, such as Boeing Flying Fortresses, were developed around the Cyclone.

THE STORY OF WRIGHT

is the story of flight, as shown in Walt Disney's "Victory Through Air Power".

CROSS sections of historic Wright engine cylinders outline the swift progress of aviation. By steady improvement in engine design and the development and adoption of stronger, lighter materials, Wright has consistently opened the way for new advances in the size and performance of aircraft. Wright research and production facilities are now providing for the present and future requirements of tonnage air transport.

Wright ENGINES

LIGHT · COMPACT · **POWERFUL**

If You Have A Vibration Problem...

Vibration-loosed connections are major sources of trouble on automobiles, bicycles and household appliances as well as on industrial, farm and office machinery. To eliminate such trouble, manufacturers who place a premium on customer satisfaction, will, in the post-war period, use Boots Nuts wherever vibration is a factor. First developed for use on airplanes, where loose connections cannot be tolerated, Boots Self-Locking Nuts withstand severest vibration—they can't come loose.

WHERE RESCUE RIDES ON LIGHTNESS

Lighter than any other nuts, Boots all-metal, self-locking nuts save from 60 to 80 pounds of weight on a single 4-engine bomber. This saving is sufficient to enable that bomber to carry a 7-man rubber life raft with 30 days' emergency rations, signal, repair and first aid kits, oars, rope, sail, scout knife, pistol, fishing tackle, whistle, bailing bucket, sea anchor and tarpaulin. Total weight 70 pounds.

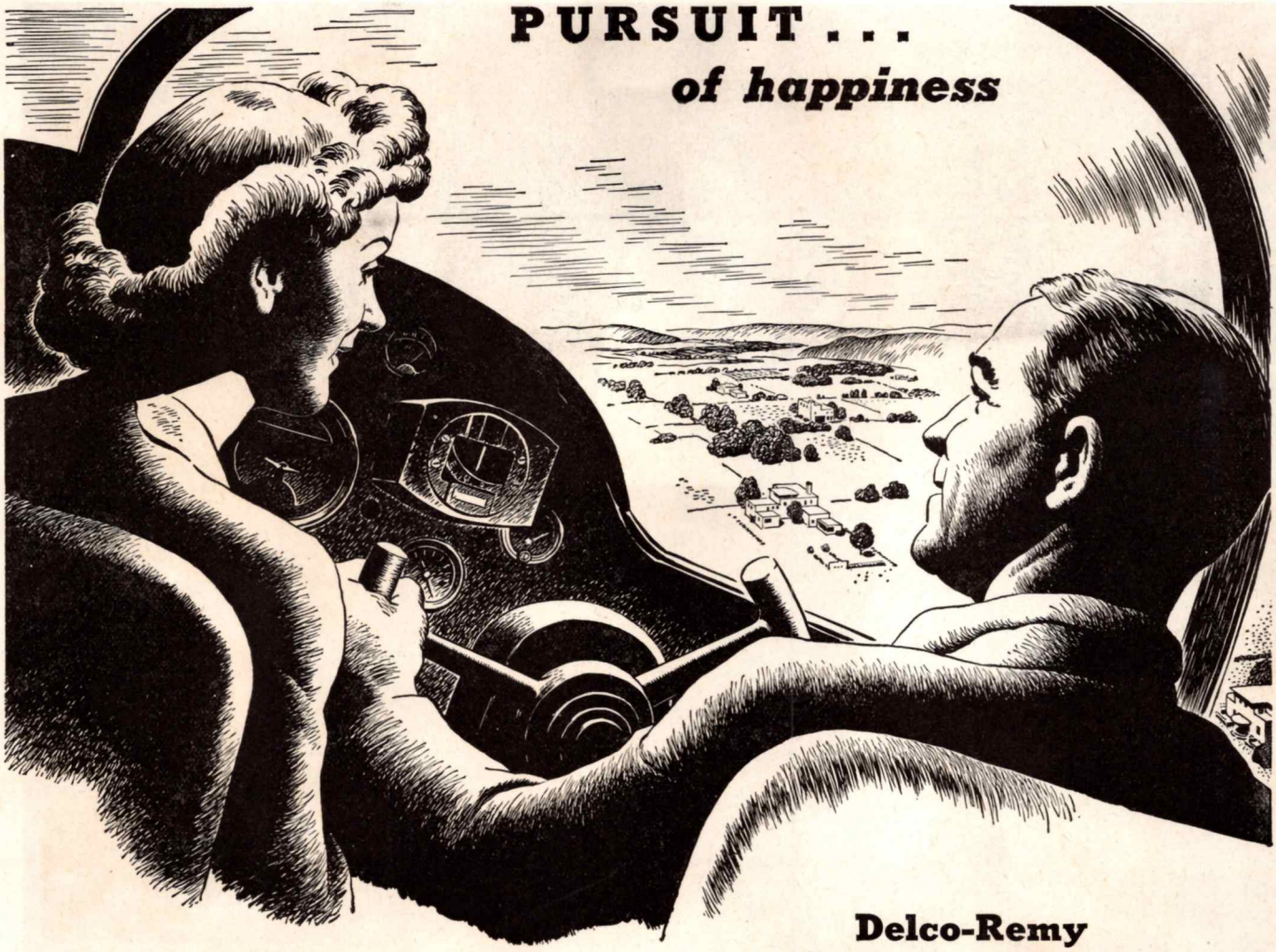
Boots Nuts meet the exacting specifications of all government agencies and are used on every type of U. S. aircraft. They withstand severest plane vibration and the corrosive action of oil, salt water or chemicals. They can be used again and again—literally "outlast the plane."

"They Fly With Their Boots on—*Lighter*"

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN, CONNECTICUT



Delco-Remy
Aircraft Electrical Equipment

In free skies where no enemy comes diving out of the sun, boys who now pilot fighter planes will find new meaning, new joy in flying. Their ships will incorporate safety equipment and engineering features developed in the laboratory of war. ¶ Delco-Remy aircraft electrical equipment is today serving on bombers and pursuit planes. It will be adapted in peace to commercial plane requirements, while the technical knowledge gained in wartime assignments will be applied to improving Delco-Remy starting, lighting and ignition for light planes. ¶ More than half of Delco-Remy's facilities are now engaged in manufacturing aircraft electrical units, precision parts and products for the aircraft industry.

ARMY E NAVY

DELCO-REMY

BACK THE ATTACK WITH WAR BONDS

DIVISION, GENERAL MOTORS CORPORATION

PRODUCTION'S "GENERAL STAFF"

War winning strategy can be represented by new ideas engineered by American industry. Techniques and "gadgets" often solve more than individual plant problems. They aid war production as a whole! For example, Solar has developed several innovations which save time, material and labor.

These are available to other manufacturers to help keep America's airpower a formidable weapon for victory. Typical product of Solar "staff work", is a new welding flux that has a higher melting point and prevents oxidation of thin gauge stainless steel and other high alloy metals.

ARMY E NAVY

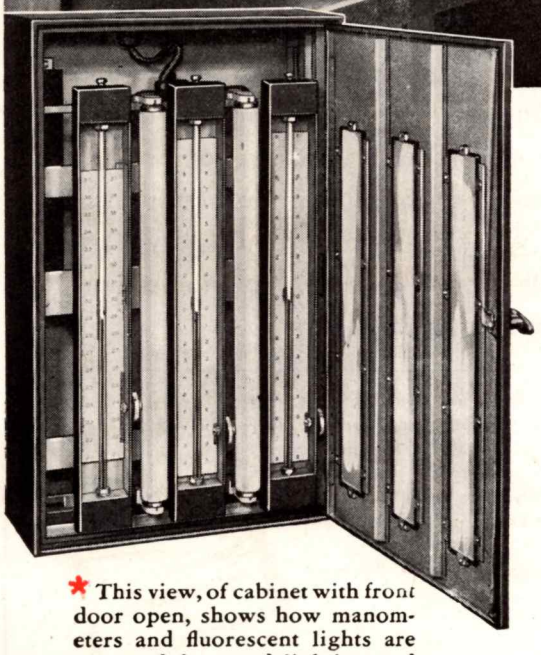
SOLAR

EXHAUST SYSTEMS—

SOLAR AIRCRAFT COMPANY ★ SAN DIEGO 12, CALIFORNIA

Modern CONTROL EQUIPMENT Speeds ENGINE TESTING

100% MERIAM EQUIPPED



★ This view, of cabinet with front door open, shows how manometers and fluorescent lights are arranged for good lighting and quick accessibility. Installation is for a prominent aircraft engine manufacturer.

THIS control equipment, for a production stand testing aircraft engines, is a highly efficient unit.

All manometers required are housed in cabinets with fluorescent lighting, providing utmost comfort and visibility in reading.

Meriam manometers measure manifold pressure, airflow, carburetor pressure drop, venturi pressure, air stack pressure, crank case pressure and other pressures, vacuums and differentials as required.

You, too, may have a measurement or test problem which Meriam instruments and engineering could solve.

THE MERIAM COMPANY

1951 West 112th Street ★ **Cleveland, Ohio**

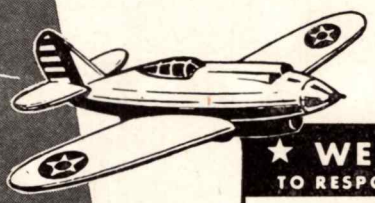
MERIAM — THE INSTRUMENT PEOPLE

ALL 3 NOW

FIGHT WIN PLAN

to be ready WHEN THE SHOOTING STOPS*

This message is especially for INDUSTRIAL EXECUTIVES who are very busy producing war goods.



★ WE OFFER ★
TO RESPONSIBLE PEOPLE

INGENUITY

along with extensive facilities for bettering anything made from metal... large or small Parts... Complete Assemblies... experimental pieces or mass production.

AFTER VICTORY

The genius that America contributes in the all-out Fight to Win can also (and at the same time) do a third thing: Plan, in a practical way, for the peace.

In our own small way we at Spriesch have been planning to help other manufacturers, After Victory. The Spriesch organization is not just another miracle war plant. Long before Pearl Harbor, we were said to be performing miracles, in the manufacture of bomb-releasing mechanisms for fighting aircraft.

Right NOW we seek contact with those to whom "All 3 at the same time" is feasible. They will like to consider using part or all of our facilities for "bettering anything made from metal" such as:

Combined engineering-dies-tools-parts or complete assemblies service...Designing and making Special Machines... Initial, periodic or continuous recommendation for product improvement or production procedure... Help on What to make After Victory. Distance will present no insurmountable barriers to rendering these services.

Industrial Executives are invited to write NOW (on business letterhead please) for our newly printed booklet, "After the Shooting Stops" and for our 36-page plastic bound brochure titled "Ingenuity." The latter illustrates and describes our extensive facilities. Frankly, we think you'll be pleased.

Joseph J. Cheney, President.

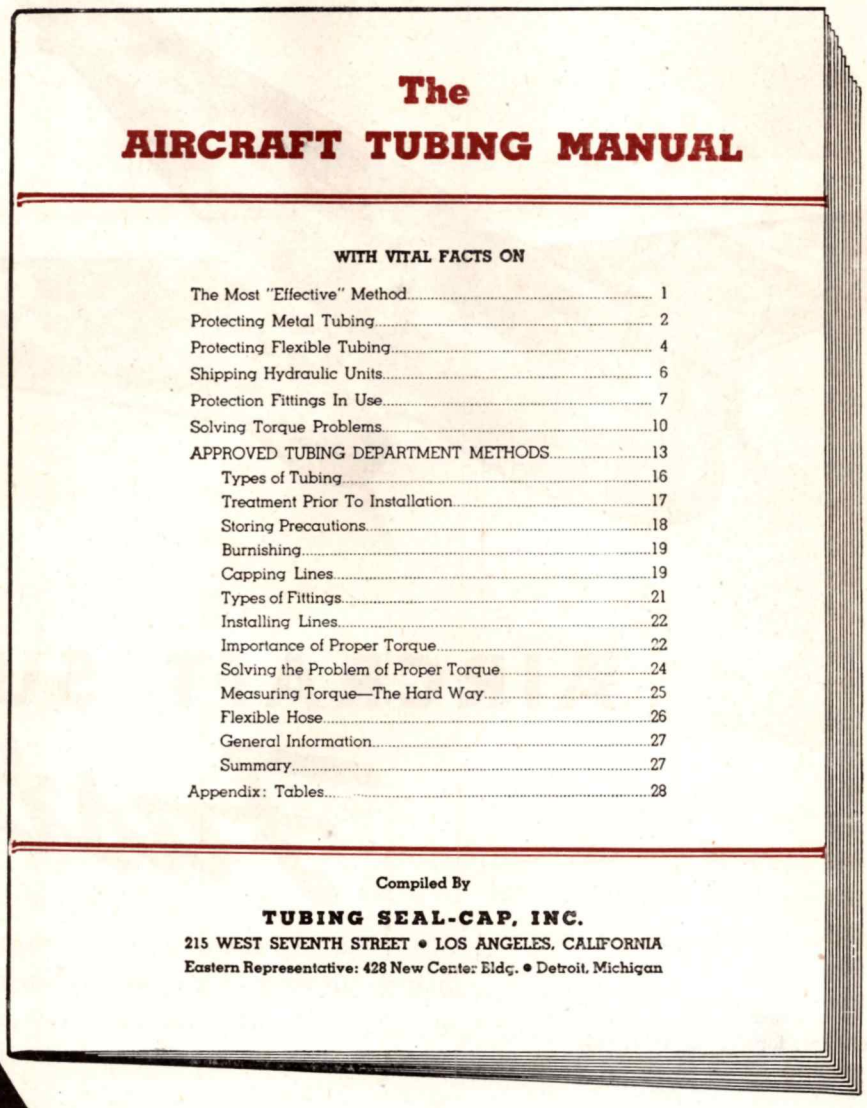
Established 1923

Spriesch TOOL & MANUFACTURING CO., Inc.

14 HOWARD STREET • • BUFFALO 6, NEW YORK

**This is a collection of articles inspired by the activities of the Spriesch organization which appeared recently in The Monetary Times, Canada, in the magazine Steel and in Printers' Ink.*

AD NO. 20



New Aircraft Tubing Manual

A complete thirty page handbook describing practical shop-proven methods for handling, storing, protecting and installing metal and flexible tubing. Including sections on insuring the precise torquing of all types of fittings and bolts... how to ship hydraulic units... photographs of work in progress... detail charts... sectional figures analysing proper tubing procedure and other valuable reference material. Available at no charge or obligation when requested on your firm letterhead. Address: TUBING SEAL-CAP, INC. – 215 WEST 7TH STREET – LOS ANGELES, CALIFORNIA. Eastern Representative – 428 New Center Building – Detroit, Michigan

AIRCRAFT SUPPLIES *Fast!*

★ ★ ★

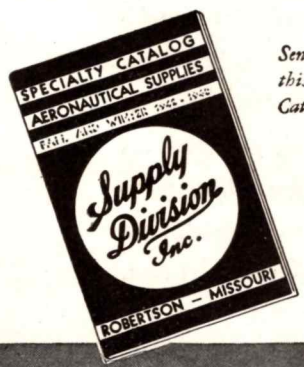
Contact either branch of Supply Division, Inc. for "same day" service . . .

LAMBERT AIRPORT, ROBERTSON, MO.
PHONE TERRYHILL 5-2902 (ST. LOUIS)

OKLAHOMA CITY, OKLA.
108 W. GRAND AV., PHONE 3-6224

★ ★ ★

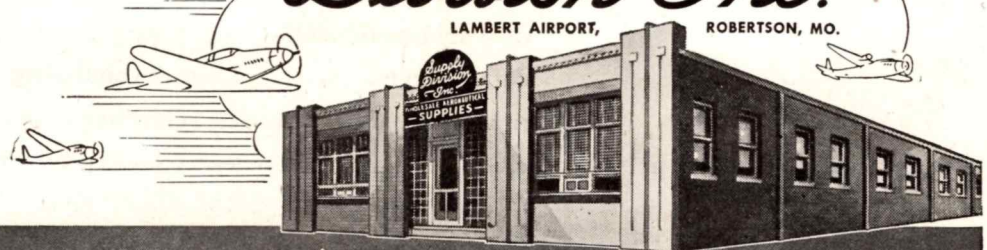
When you need parts, materials or accessories—and need 'em in a hurry—call Supply Division, Inc. The business of this company, as symbolized by the above illustration, is made up of aircraft nuts, bolts, turnbuckles, etc. It has rendered emergency supplies service to aircraft manufacturers and dealers for more than eleven years. Today *two* conveniently located warehouses, fully stocked with every available type of aeronautical specialty, are ready to fill your requirements . . . intelligently and speedily.



Send for a copy of this new Specialty Catalogue

SUPPLY *Division Inc.*

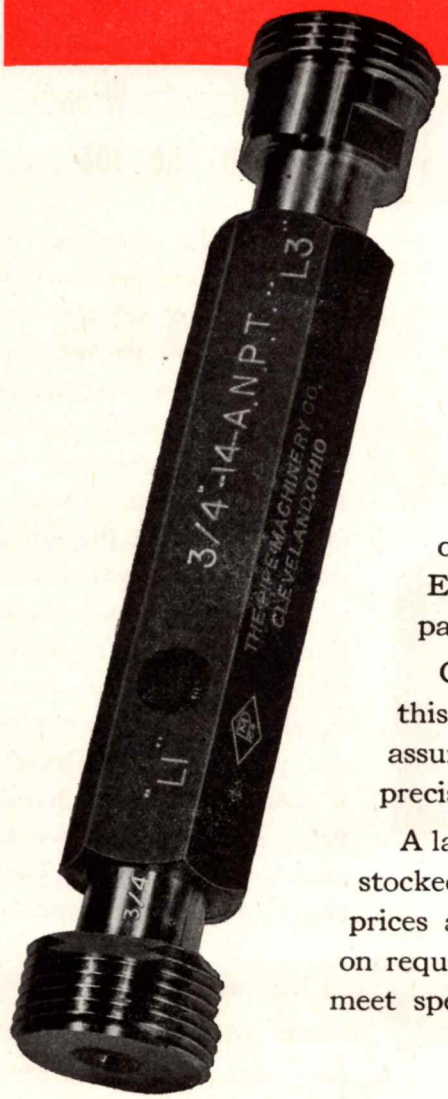
LAMBERT AIRPORT, ROBERTSON, MO.



YOUR *"Warehouse Annex"* FOR AERONAUTICAL SUPPLIES

100,000 GAGES

FOR ONE JOB!



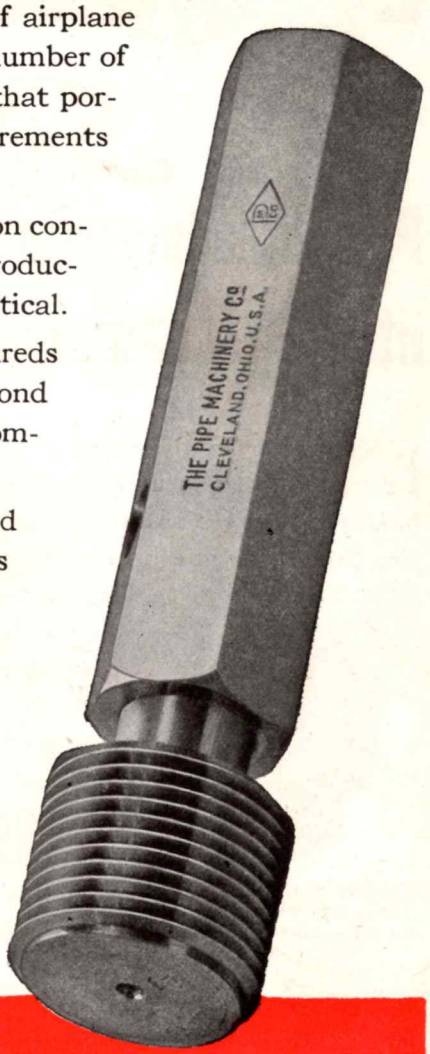
One of the leading builders of airplane engines has that tremendous number of gages in constant use—a fact that portrays vividly the precision requirements of modern manufacturing.

Without this accurate dimension control, our American straight-line production methods would hardly be practical.

Many of the gages used in hundreds of war plants carry the PM Diamond Emblem of The Pipe Machinery Company.

Gage users have learned to regard this emblem—on a gage or tool—as assurance of high standard accuracy, precision and perfect finish.

A large number of standard gages are stocked for immediate shipment. And prices and delivery dates will be sent on request, to cover gages designed to meet special requirements.



PM CO

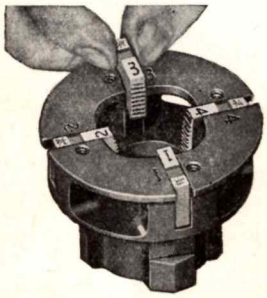
The PIPE MACHINERY COMPANY Cleveland, O.

GAGES • HOBS • MILLING CUTTERS • SPECIAL TOOLS

Speedier

Pipe Threading with this smooth little RIDGID No. 11R

IT'S always hurry these days. Well, if your rush is to thread 1/8 to 1¼ inch pipe, grab up this little RIDGID No. 11R, snap the size head you want into the drive ring from either side (it can't fall out) and start threading in swift easy ratcheted strokes. If it's a short pipe and close to the wall, simply reverse the chasers — no special dies needed. A rugged steel-and-malleable tool that takes stiff punishment. Patented wire carrier free with sets. Ask your Supply House for this smooth little RIDGID No. 11R.



Chasers of these RIDGID Threaders reverse *quickly* for close-to-wall threads.

RIDGID Scraps Your Wrench Housing Repair Problem

★ UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
COPR. 1937 THE RIDGE TOOL CO. ELYRIA, O.

This Guarantee means RIDGID Wrenches Stay on the Job . . .

UNDER war emergency or post-war competition you can't afford to waste either time or money repairing pipe wrenches. That makes RIDGID important to you. The guaranteed housing practically insures you against wrenches out of order, off the job — cuts expense and spares needed. And it's faster easier to use. Handy pipe scale on hookjaw, adjusting nut in open housing always spins easily to pipe size, powerful I-beam handle is comfortable to the hand. For a trouble-proof work-saver tool . . . always ask your Supply House for RIDGID.

RIDGID End Wrench for pipe in coils or against flat surfaces. Made in sizes E6" to E36".

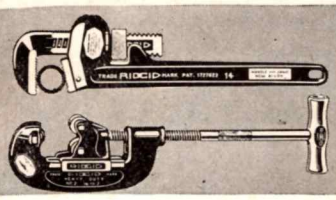
Buy RIDGID Pipe Tools at Supply Houses Everywhere

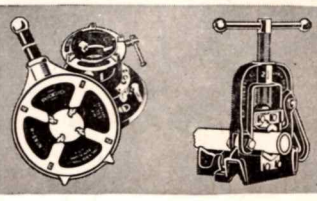
RIDGID

★ PIPE TOOLS ★

Fast-Working Tools for War . . . and the Busy Peace that's Coming

THE RIDGE TOOL COMPANY
ELYRIA, OHIO, U.S.A.





HE SHOUTS COMMANDS IN A WHISPER!

With a rumbling rush that shakes the earth and blazing guns that fill the air with chattering fury, iron men in tanks of steel go crashing through the enemy lines.

And directing the onslaught of this armored force is a voice made sure and strong by war . . . the battle voice of radio. Though commands may be spoken in but little more than a whisper, this voice cuts clearly through the surrounding din and uproar of action . . . calls the plays for tank teamwork that wins.

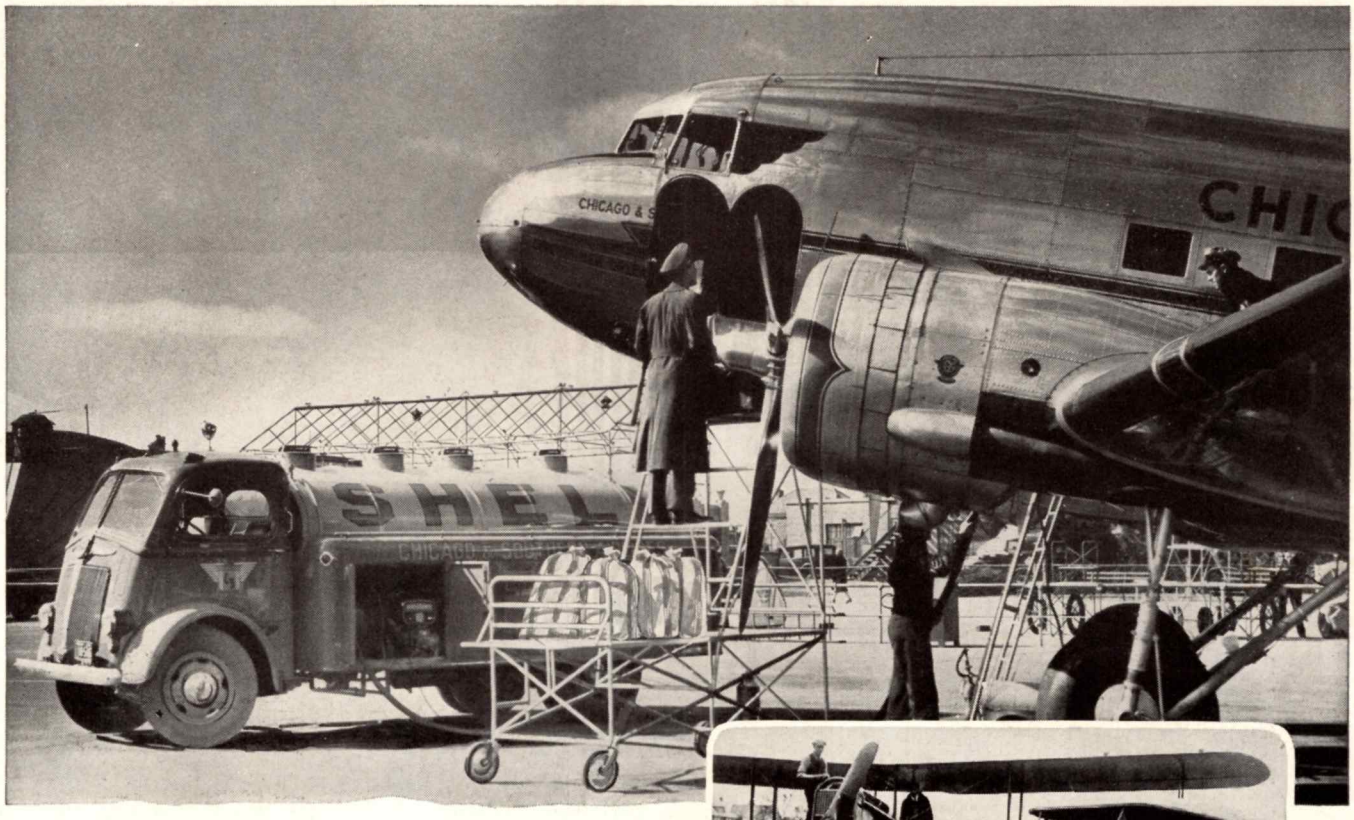
On land, on sea, and in the air, radio and Radar equipment is helping to write the history of this war. When that history has been completed by victory, Belmont will have an interesting story to tell . . . a story of wartime developments applied to better products and better living in a peacetime world. Belmont Radio Corporation, 5921 W. Dickens Ave. Chicago 39, Ill.

Belmont Radio

TELEVISION ★ FM ★ ELECTRONICS

KEEP BUYING WAR BONDS!

WHITE KNOWS TRANSPORTATION *FROM THE GROUND UP*



THE TRUCK with

A Quarter-Century Experience in *Aviation*

IN 1918 . . . when U. S. "Aerial Mail Service" was inaugurated . . . this sturdy White was on hand to furnish the dependable ground link. Today, at airports across the continent and abroad, Super Power Whites perform a score of essential "ground crew" transportation services. Hauling mail and cargo . . . refueling planes . . . delivering food and cooked meals . . . serving as mobile air conditioning units . . . building and maintaining runways and clearing them of snow and ice in winter. These are only a few of the ways in which White trucks serve modern aviation.

This quarter-century of "growing up" with aviation has given White not only a background of experience in meeting the industry's specialized truck needs, but also a keen desire to be a part of the bettered transportation of the future which aviation's progress has assured.

Whatever form air cargo takes . . . *dependable, time-saving ground transportation must be an essential part of it.* White has interesting cost estimates and time study figures available. Write for these or any information regarding your present or proposed requirements.

★ White ★

THE WHITE MOTOR COMPANY • Cleveland

Builders of U. S. Army Tank Destroyers, Scout Cars, Half-Tracs, Prime Movers and Cargo Trucks, the complete line of Super Power Trucks and Tractors, City and Inter-City Coaches, Safety School Busses and the Famous *White Horse.*

FOR MORE THAN 40 YEARS THE GREATEST NAME IN TRUCKS

Photo courtesy of Republic Aviation Corp.

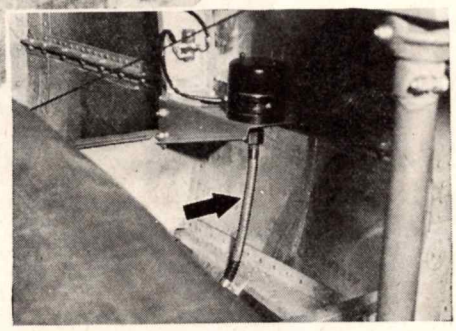
—A tribute to the prowess of the fast, powerful 2000 h.p. Republic P-47 THUNDERBOLT and to the outstanding courage and skill of our boys who fly and fight them.

And it is likewise a tribute to the equipment that plays its part in the functioning of this super-fighter.

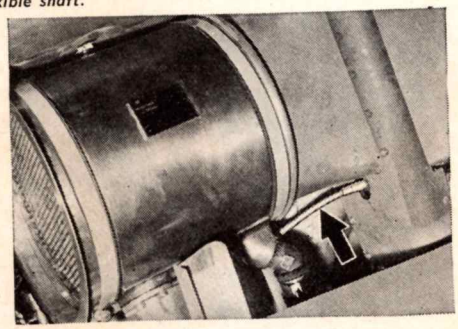
To us, in our all-out war effort, it is a source of great satisfaction that S. S. White Flexible Shafts are serving in the THUNDERBOLT, and also in practically all other U. S. combat and transport planes. The full story of the contribution of S. S. White Shafts to war-time aircraft, when it may be told, will prove amazing.

Excellence of product and authoritative engineering assistance when needed, explain why S. S. White has come to be the Aviation Industry's flexible shaft headquarters.

Consult S. S. White when you need flexible shafts or have a mechanical power drive or remote control problem.*



This generator for the turbo tachometer in the P-47 is driven from the engine by an S. S. White power drive type flexible shaft.



Smooth, accurate remote control of the oil cooler installation on the P-47 is accomplished with an S. S. White remote control type flexible shaft.

**The need for our shafts in planes and other war equipment confines our production and service to war work until Victory is won*

S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

Dept. F. 10 East 40th Street, **New York 16, N. Y.**

FLEXIBLE SHAFTS • AIRCRAFT ACCESSORIES • MOLDED PLASTICS PRODUCTS

Will the Helicopter be our most versatile war-bird?

RECENT news releases divulged that the United States Army had placed the world's first large-scale order for helicopters —that an additional swarm had been ordered for use in anti-submarine warfare.

This revolutionary rookie flies forward, backward, sideways, straight up, straight down—hovers at any height. It can drop a ton of depth-charges or bombs, spot artillery targets, lay miles of signal corps wire in minutes. It can deliver breakable supplies and ammunition—even to troops in dense forest — can communicate by telephone (as Mr. Sikorsky is doing in the accompanying illustration), land messengers and haul up wounded men.

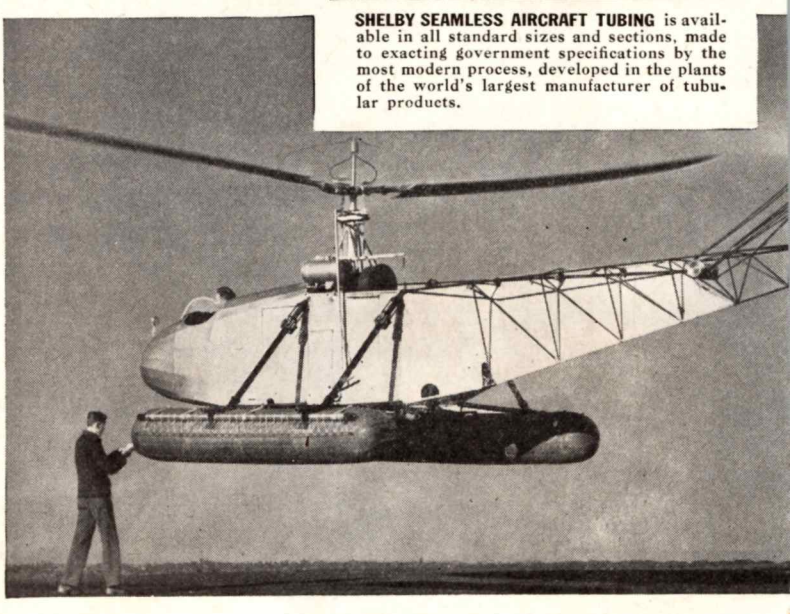
Muffled to relative quiet, it can perform night missions behind enemy lines. On pontoons it can take off from a freighter's deck for liaison and observation duty—can land on water, swamp, snow, or back on deck.

The modern helicopter's wartime uses are countless, as are the improvements in design and construction through which it has been developed toward perfection. Prominent among them are the many applications of seamless steel tubing.

In rotor standards, fuselage frames, engine mountings, landing gears and pontoon braces, the helicopter relies on the same steel tubing that has proved its mettle in so many of our modern fighters and bombers. For rigidity, high strength-weight ratio and rugged durability — proved in combat service — plane manufacturers have put the seal of their approval on SHELBY Seamless Aircraft Tubing.

Keep fully informed on aircraft tubing. Write for your copy of Bulletin No. 16.

SHELBY SEAMLESS AIRCRAFT TUBING is available in all standard sizes and sections, made to exacting government specifications by the most modern process, developed in the plants of the world's largest manufacturer of tubular products.



NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* United States Steel Export Company, New York

UNITED STATES STEEL

ONLY SKILL AND EXPERIENCE PRODUCE THE MASTERPIECE...

GOOD coordination of hands and eyes that comes with long experience is a major factor in the production of both fine pottery and Wellman non-ferrous castings. • That extra measure of quality we have always featured frequently means real savings in time and cost in machining and assembly. • Another advantage of our long experience is the fact that on new castings we can often get into production months sooner. • Castings in Ampco Bronze, Well-cast Magnesium, Brass, Bronze and heat-treated Aluminum Alloys. • Patterns of all sizes, kinds and designs, in metal or wood.

THE WELLMAN BRONZE & ALUMINUM COMPANY

GENERAL OFFICES: 2527 EAST 93RD STREET • CLEVELAND 3, OHIO

WOOD & METAL PATTERNS AND CASTINGS

WELLMAN *means* WELL-CAST

WELLMAN

CASTINGS X-RAY INSPECTED

A FAST-DRYING FINAL COATING FOR YOUR HIGH SPEED PRODUCTION SCHEDULES!

No. 4 in a series of Laboratory Data Sheets on Specification Finishes. Save and file these pages ...or send for a standard-size report form punched to fit your binder.

★

Write today for our new and complete file folder of U. S. Army, Navy, and Air Force Specification Finishes . . . and remember that our laboratory is at your service in the development of new and improved formulations to meet specific finishing problems. Send for folder describing our modern production facilities.

TESTOR CHEMICAL CO. TESTORS ROCKFORD, ILL., U.S.A.

CONTROL LABORATORY DATA SHEET

CAMOUFLAGE LACQUER, CELLULOSE NITRATE
PRODUCT

14105B Army Air Force SPECIFICATION NO.	219 BATCH NO.

APPEARANCE: Homogeneous, smooth dries to lusterless finish. Color: Olive Drab #41.

TOXICITY: Non toxic

NON-VOLATILE: 46%

VISCOSITY: 1.35 poise at 25°C. when 2 volumes lacquer are thinned with 1 volume Thinner (AN-TT-T-256).

WORKING PROPERTIES: Good leveling. Wet hiding power (Thinned Lacquer) 1200 Sq. Ft. per Gal. (Pfund Cryptometer).

DRYING TIME: To touch - 2 1/2 minutes; hard in 10 minutes.

LIFTING PROPERTIES: Non-lifting at any time.

ADHESION: Excellent adhesion to zinc chromate primed surfaces, aluminum and steel.

RESISTANCE TO FLUIDS: Immersion in water and aliphatic hydrocarbon does not affect the lacquer film.

FLEXIBILITY: Withstands 180° bend around 1/8" diameter rod after 96 hours bake at 212°F.

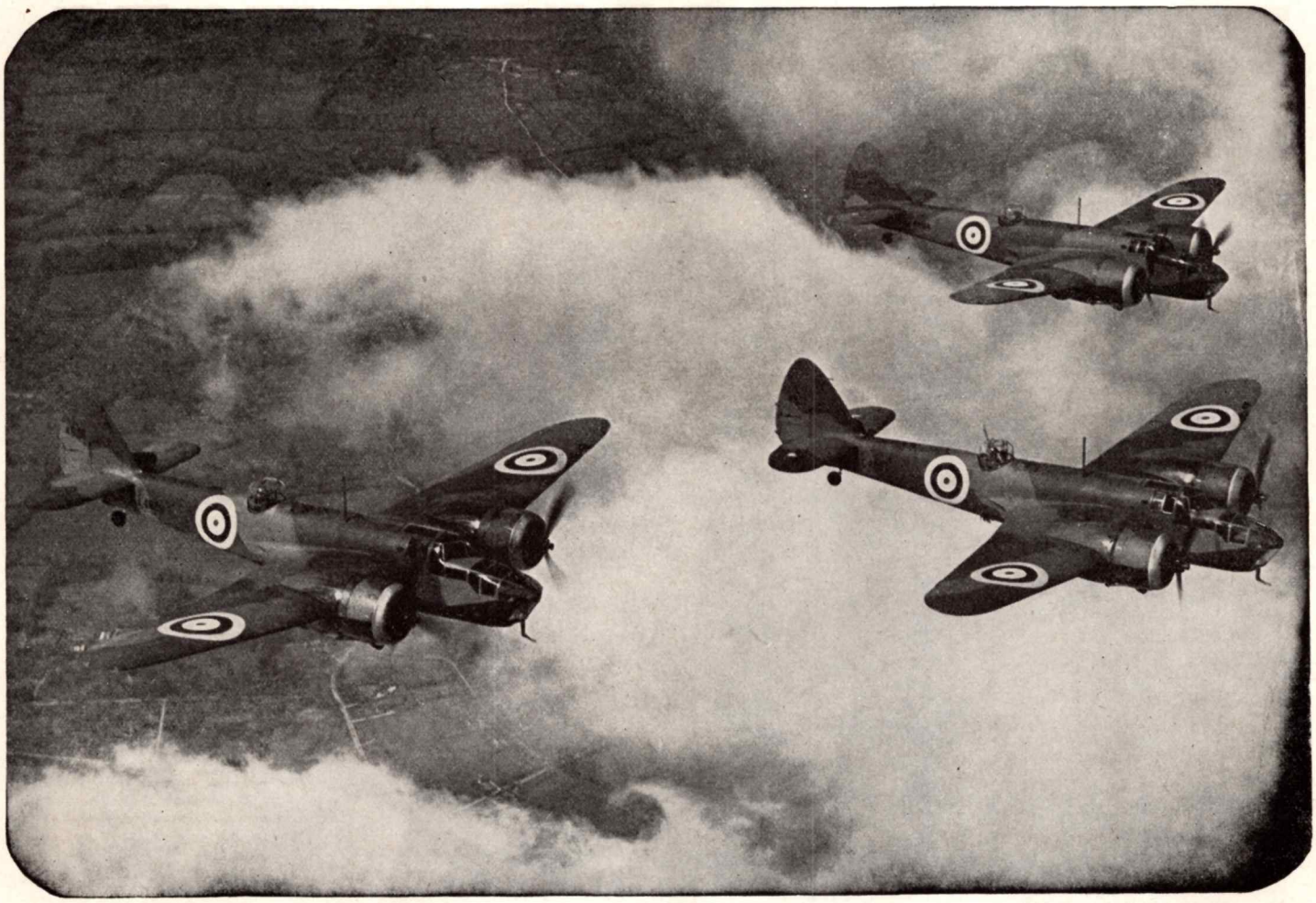
INFRA-RED REFLECTANCE: Has infra-red reflectance lower than Aircraft Gray and higher than Olive Drab Porcelain Standards.

REMARKS: 14105B Camouflage Lacquer is a fast drying final coating for high speed production schedules. Its excellent durability, resistance to water and hydrocarbons, good adhesion and quick dry time perform the work of an ideal aircraft finish.

TESTORS

AIRCRAFT FINISHES

TESTOR CHEMICAL CO., ROCKFORD, ILLINOIS, U.S.A.



WEEMS SYSTEM OF NAVIGATION

AIR Navigators are urgently needed to fly American planes to all corners of the world and to man the Nation's expanding Air Force.

Learn all phases of air navigation by studying the Weems System of Navigation which is now used extensively by the United States and other governments, by commercial airlines, and sportsmen pilots.

Prepare now for one of the better positions which will be available in an expanding commercial aviation.

You may avail yourself of the Weems System either through our home study course or through our individual or class instruction which is now provided in the following cities: Annapolis, Baltimore, Boston, Denver, Los Angeles, Miami, New Orleans, New York, Philadelphia, San Diego, San Francisco, Seattle, Springfield, Washington, D. C.

You who wish to further your present knowledge of navigation will find many of the texts and instruments used in the Weems System invaluable and may purchase these separately without necessarily taking the full air navigation course.

AIR NAVIGATION, Weems	$3.50
LEARNING TO NAVIGATE	2.00
SIMPLIFIED CELESTIAL NAVIGATION, Weems & Link	1.50
RADIUS OF ACTION OF AIRCRAFT, Tornich	3.00
INSTRUMENT FLYING, Weems & Zweng	4.00
LINE OF POSITION BOOK, Weems	1.50
STAR ALTITUDE CURVES, Weems, per 10° Lat. Band	5.00
NAVIGATION NOTE BOOK & PLOTTER, Weems	3.60
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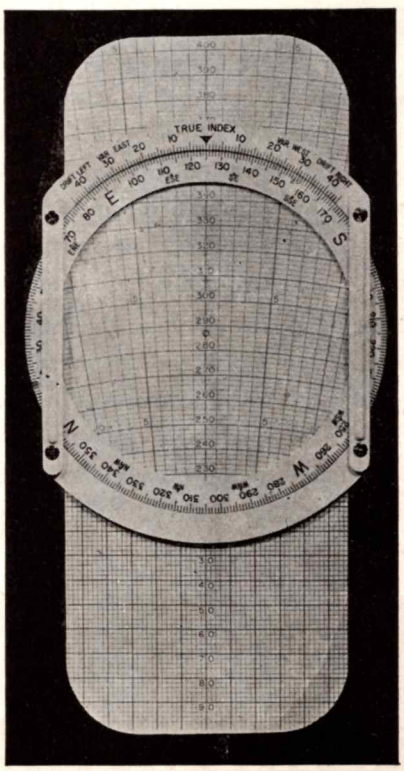
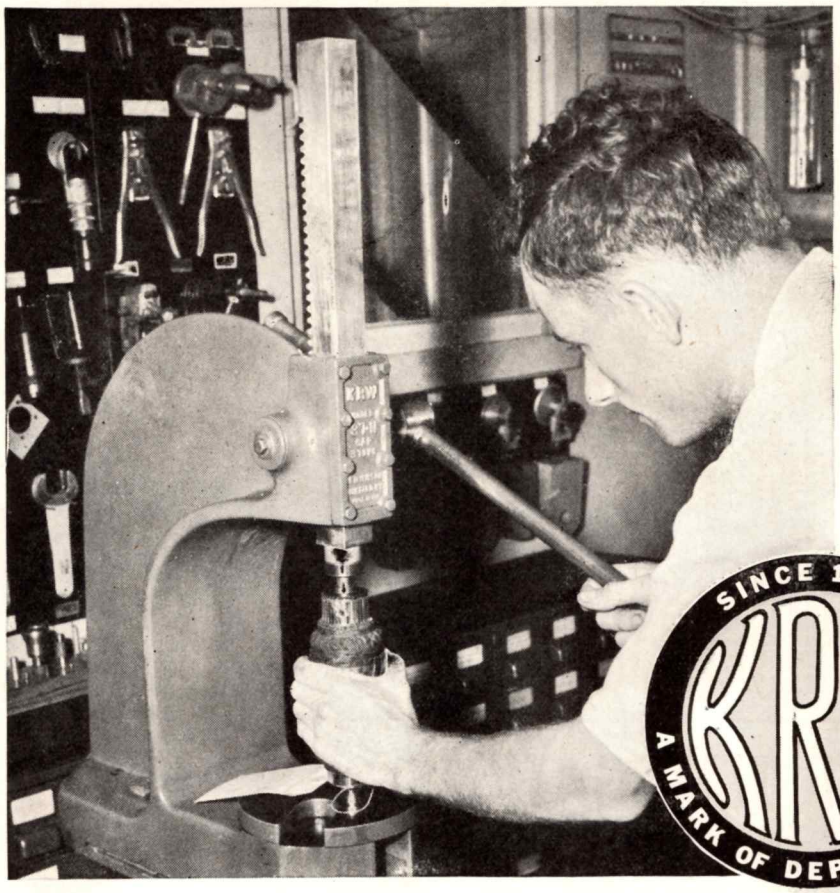
WSN COURSE AND DISTANCE PROTRACTOR	5.00
DALTON COMPUTERS, MARK VII OR E-1A	7.50
DALTON COMPUTER, E-6-B	10.00
BROWNELL-WEEMS STAR FINDER	5.00
SPEED-TIME-DISTANCE CALCULATOR	1.00
LYON COMPUTER, U.S. Coast & Geodetic Survey Type	3.00
GILLMER COMPUTER	3.00
SEA AND AIR RESIDENCE AND HOME STUDY COURSES	Various

WEEMS SYSTEM OF NAVIGATION, Annapolis Maryland



Dalton Computer, E-6-B, "Standard with Navy and Army Air Force."

PAN AMERICAN USES KRW EQUIPMENT TO

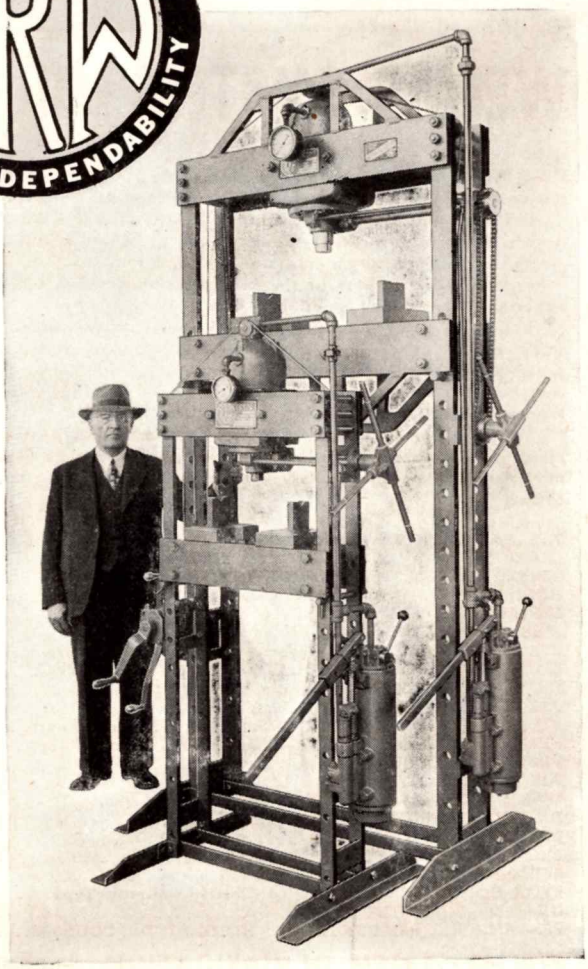


"Keep 'em Flying"

Illustration at left shows a KRW 3-ton Bench Type Arbor Press in use in Pan American shops.

SINCE 1916 KRW A MARK OF DEPENDABILITY

Illustration below shows a special extra high 75-ton KRW Hydraulic Arbor Press in comparison with the standard 25-ton unit.



● Girdling the globe as it does, and with every Clipper serving some phase of the war effort, Pan American insists on the best possible equipment in its shops—to speed overhaul and increase the number of trips per plane per month. That you find them using KRW Arbor Presses and other equipment is further proof of this policy.

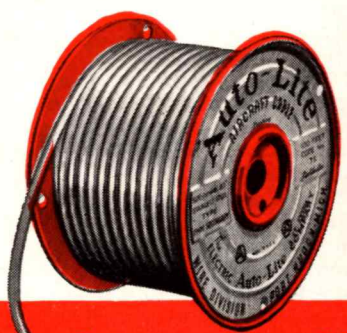
KRW Hydraulic Arbor Presses are Engineered for War Production. Hundreds of them have already been speedily adapted to handle many unusual production jobs—without time-consuming engineering delays. KRW builds standard Hydraulic Arbor Presses in 25, 50, 60 and 75-ton capacities and Bench Type Arbor Presses in 1/2, 1 and 3-ton capacities.

K. R. WILSON
10 LOCK ST., BUFFALO 2, N. Y.

... and Points North·East·South and West

Blazing air trails all over the world, Pan American Clippers . . . intrepid "Merchant Marine of the Air" . . . have become an integral part of the United Nations' war effort. And to help keep those powerful 4-engine transports aloft through fog, rain, snow and sleet, Pan American engineers specify Auto-Lite Ignition Cable as standard equipment.

For landing gear lights, radio and "intercom," instruments, guns, pumps and other phases of low tension circuit required by aviation, Auto-Lite also produces wire and cable that meet the standards of Army-Navy Specification AN-JC-48. Greatly increased resistance to abrasion and appreciably longer life is definitely assured with Auto-Lite's new "B-Braid" covering and "CA" lacquer. Our Form No. 838 contains complete information on these points. Write for your copy today.



THE ELECTRIC AUTO-LITE COMPANY

PORT HURON, MICH. *Wire Division* SARNIA, ONTARIO

AUTO-LITE AIRCRAFT WIRE and CABLE

IN ITS 26 GREAT MANUFACTURING DIVISIONS, AUTO-LITE IS PRODUCING A LONG LIST OF ITEMS FOR AMERICA'S ARMED FORCES ON LAND, SEA AND IN THE AIR

The Mobile Machine Shop Prizes a Part from the Food Mixer

IT MIGHT SEEM strange that a truck equipped to make repairs in the field should find anything of value in a household kitchen mixer. The food mixer is a "lady's man" and so must be trim, light in weight, and stout-hearted. That's why food mixer manufacturers prefer Torrington Needle Bearings—their compact size and ease of lubrication give this modern kitchen equipment much of its "sex appeal."

The mobile machine shop, on the other hand, is *designed* for repair work. Rugged, hard-driven, it is equipped with various kinds of machine tools to do just that. But it was the repair and servicing of planes, tanks and other mechanized equipment "knocked out" in battle that our Armed Forces had in mind when they designed the mobile machine shop. And the Needle Bearing's adaptability to machine tool design looked to Army engineers, as it did to the food mixer people, like just their dish. As it turned out, there were *other* features on the bill of fare of this unusual anti-friction bearing that any repair crew in the field would welcome—the ability to stand up in the severe service a mobile machine shop knows... effective lubrication, low coefficient of friction, increased efficiency of operation...and, of course, the fact that it needs so little attention.

NEEDLE BEARINGS— ALL TYPES—ALL SIZES

NEEDLE BEARINGS TYPE DC are complete, self-contained units consisting of a full complement of rollers and a drawn, hardened outer race. They offer the advantages of small size, low cost, high capacity—and easy installation.

NEEDLE BEARINGS TYPE NCS consist of a full complement of rollers and a relatively heavy hardened outer race. They are furnished with or without inner races. Needle Bearings Type NCS are adaptable to heavier loads than Needle Bearings Type DC.

NEEDLE ROLLERS TYPE LN are produced in a range of types and sizes for assembly on the job into low-cost, high-capacity, anti-friction bearing units. Our engineering department will be glad to advise on the correct size and type for any application.

THE POINT IS YOUR POSTWAR DESIGNS

In considering ways to improve your own product's design for postwar, there's more than one useful idea in the Needle Bearing. For war work has awakened many of *your customers* to the advantages, in performance and cost economy, of compact design, savings in weight, infrequent lubrication and long service life—features which identify the Torrington Needle Bearing. Torrington engineers will be glad to assist you in adapting this new-day bearing to your future designs. Catalog No. 112 listing sizes, ratings and typical applications will prove helpful, also, as preliminary information.

THE TORRINGTON COMPANY

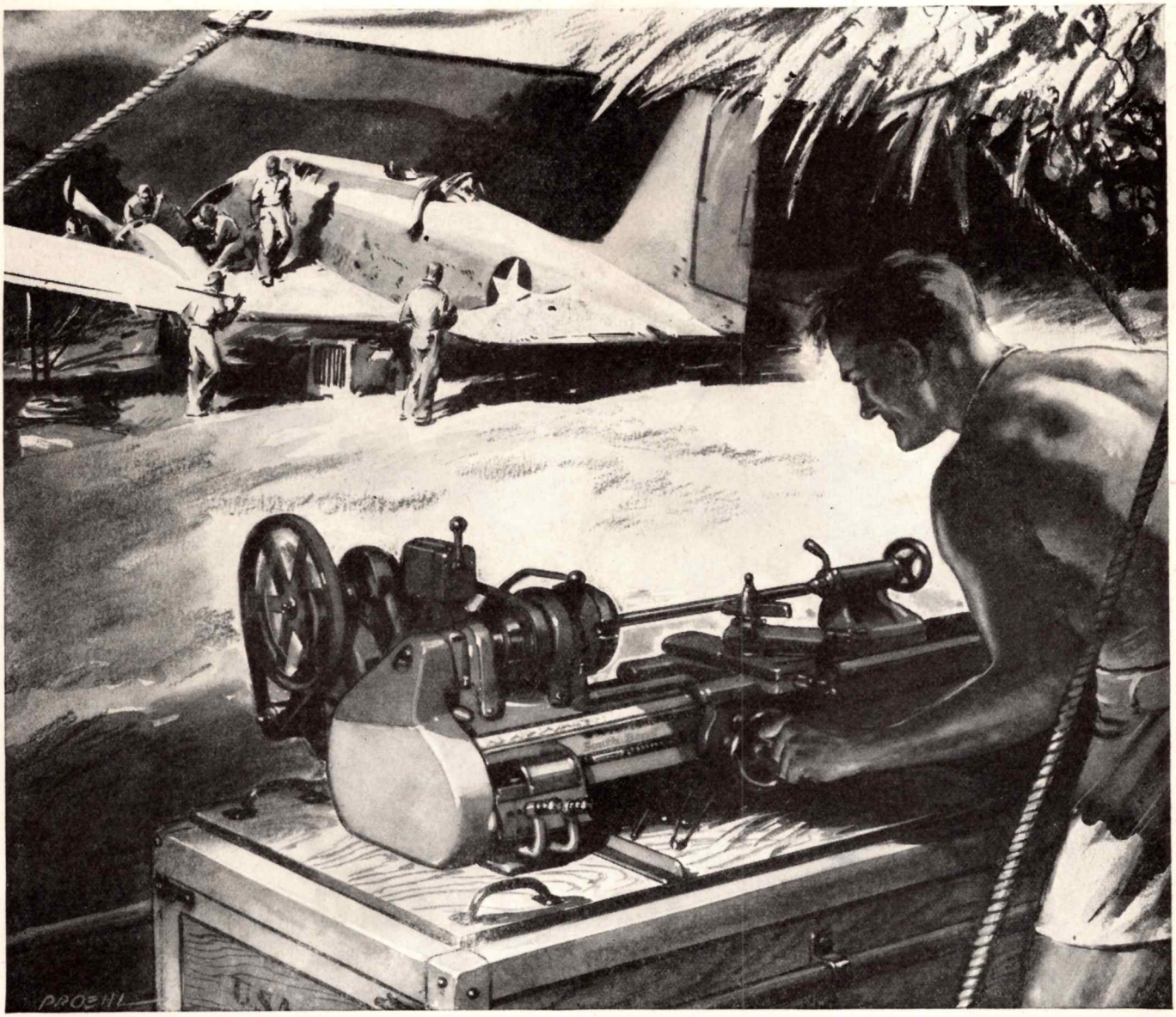
Established 1866 • Torrington, Conn. • South Bend 21, Ind.

Makers of Needle Bearings and Needle Bearing Rollers

New York Boston Philadelphia
Detroit Cleveland Seattle
San Francisco Chicago Los Angeles
Toronto London, England

LET'S GO! U.S.A. 1943 KEEP 'EM FLYING

TORRINGTON NEEDLE BEARINGS



The Flying Lathes of the Air Corps

One of the toughest jobs of the Air Corps Technical Service is to get disabled planes back into the air when they have been forced down in remote locations. No matter where the plane is grounded, skilled technicians must get there quickly with all the tools and equipment required to make emergency repairs.

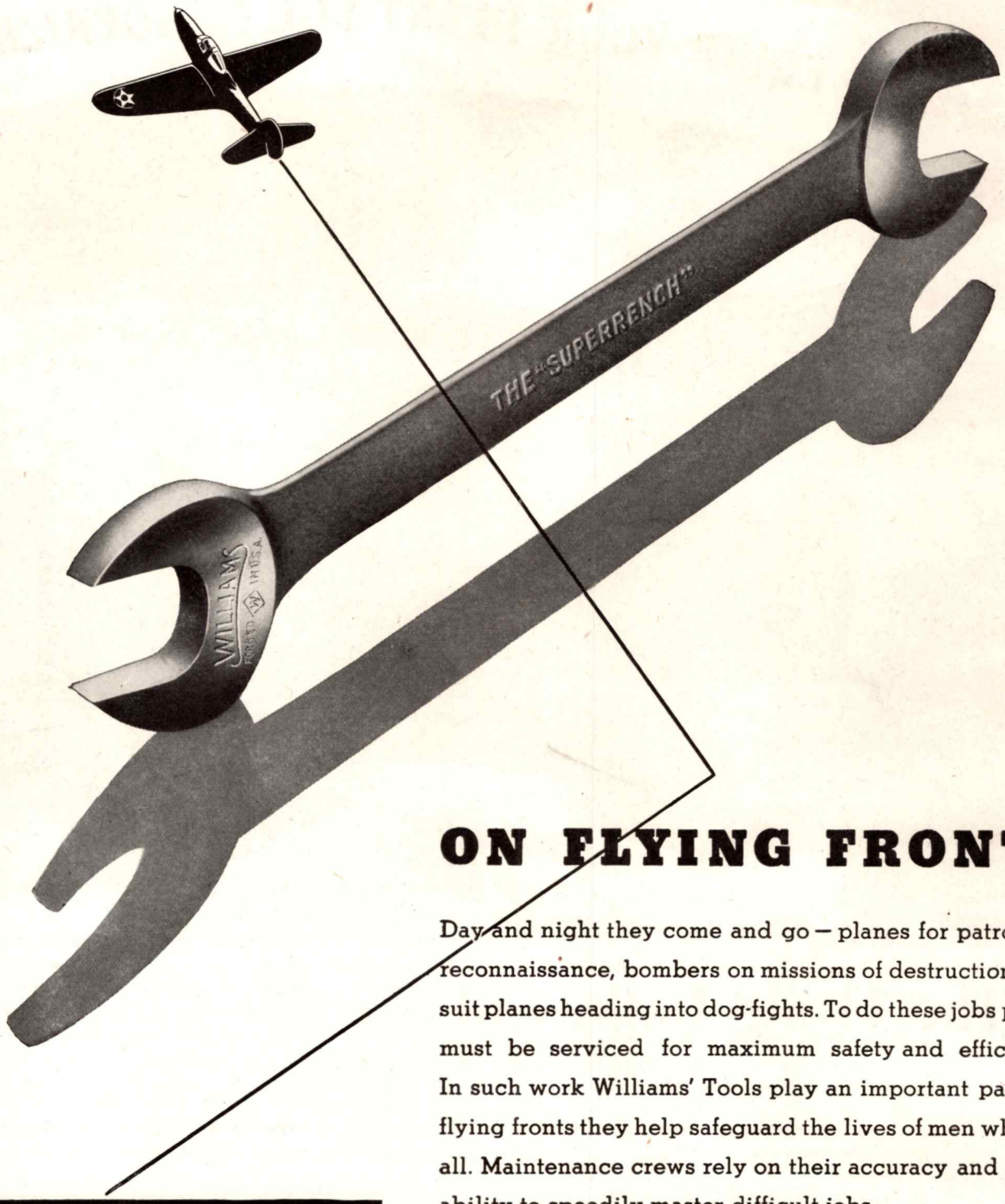
Buy War Bonds!

Precision machine operations are sometimes required—so the Air Corps is prepared to fly a Precision Lathe wherever a plane can land. Packed in special, lightweight cases and fitted with accessories for doing a variety of work that would surprise you, these flying lathes are an important part of the Air Corps' emergency service equipment.

We are proud that South Bend Lathes have been selected for this important service—one of many vital assignments that are keeping South Bend Lathes busy for the duration.

SOUTH BEND LATHE WORKS

SOUTH BEND, INDIANA **LATHE BUILDERS FOR 36 YEARS**



ON FLYING FRONTS

Day and night they come and go — planes for patrol and reconnaissance, bombers on missions of destruction, pursuit planes heading into dog-fights. To do these jobs planes must be serviced for maximum safety and efficiency. In such work Williams' Tools play an important part. On flying fronts they help safeguard the lives of men who risk all. Maintenance crews rely on their accuracy and adaptability to speedily master difficult jobs.

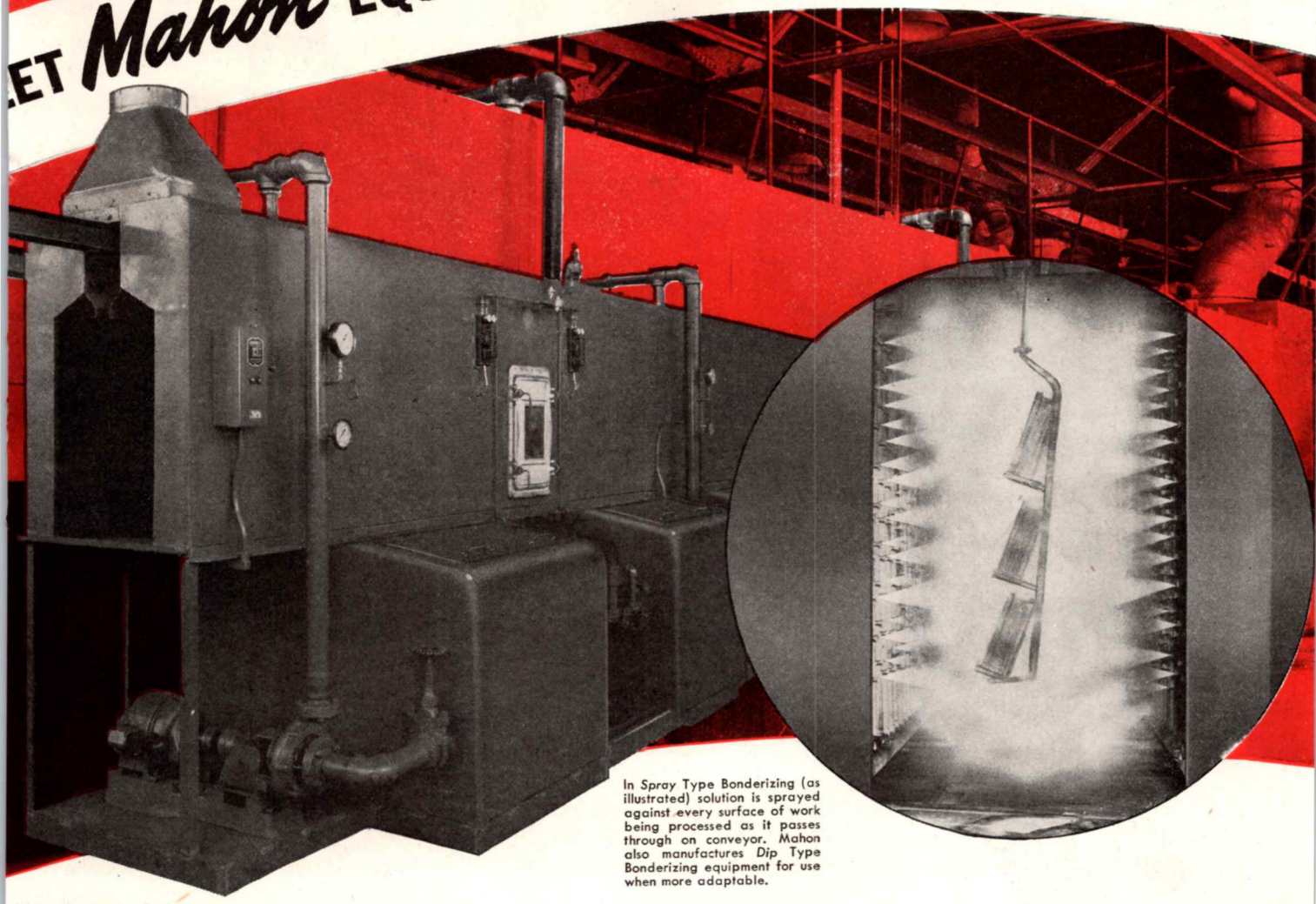
Williams' Tools are prized possessions. Supplies are limited as the need of the war effort must be served first. Carefully used, the ones you now have will last until after Victory when there will again be tools for all.

WILLIAMS
SUPERIOR DROP-FORGED TOOLS
DROP-FORGINGS & DROP-FORGED TOOLS

J. H. WILLIAMS & CO. BUFFALO, NEW YORK

Williams will gladly send their booklet of helpful suggestions: "How To Select and Use Wrenches". Just write.

LET *Mahon* EQUIP YOUR PLANT FOR BONDERIZING

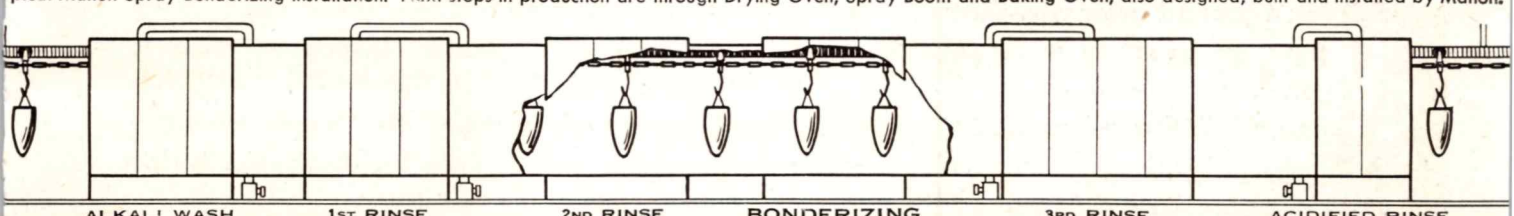


In *Spray* Type Bonderizing (as illustrated) solution is sprayed against every surface of work being processed as it passes through on conveyor. Mahon also manufactures *Dip* Type Bonderizing equipment for use when more adaptable.

Mahon Bonderizing Equipment is built to fit your plant and product. All details of installation—type of conveyor — heating — controls, etc. — are given individual consideration.

Bonderizing long has been accepted as an outstanding method of producing an effective bond between paint and steel—and as a rust repellent. For as many years as the process has been in use, Mahon engineers have been planning, producing and installing equipment essential to its proper application. Hundreds of Mahon-engineered installations are now in operation—adapted to every conceivable size, shape and type of product. New requirements in airplane manufacture have established the need for bonderizing in many aircraft plants—and the demand for Mahon equipment. If manufacturing specifications call for the bonderizing of any of your parts, let Mahon design and build the equipment you'll need. Whether you require a bonderizing unit to fit into your present production line—or whether you desire a completely new and modern finishing system—including bonderizing—the knowledge and experience of Mahon engineers will prove immensely valuable. Production will be placed on a fast-moving, highly efficient and economical basis.

ypical Mahon Spray-Bonderizing installation. Next steps in production are through Drying Oven, Spray Booth and Baking Oven, also designed, built and installed by Mahon.



THE R. C. MAHON COMPANY

DETROIT CHICAGO

anufacturers of Metal Cleaning Machines • Rust Proofing Machines • Hydro-Filter Spray Booths • Ovens of All Types • Filtered Air Supply Units • Hydro-Foam Dust Collectors—and Many Other Units of Special Production Equipment—including Complete Finishing Systems

First in Service

ASK THE MEN WHO USE THEM

THE PROOF of a fastener is the way it works. Tests for shear strength, tension, vibration and endurance cannot give the whole story. But ask a ground crew why they rate Airloc fasteners *first* in actual service and they will tell you . . . .

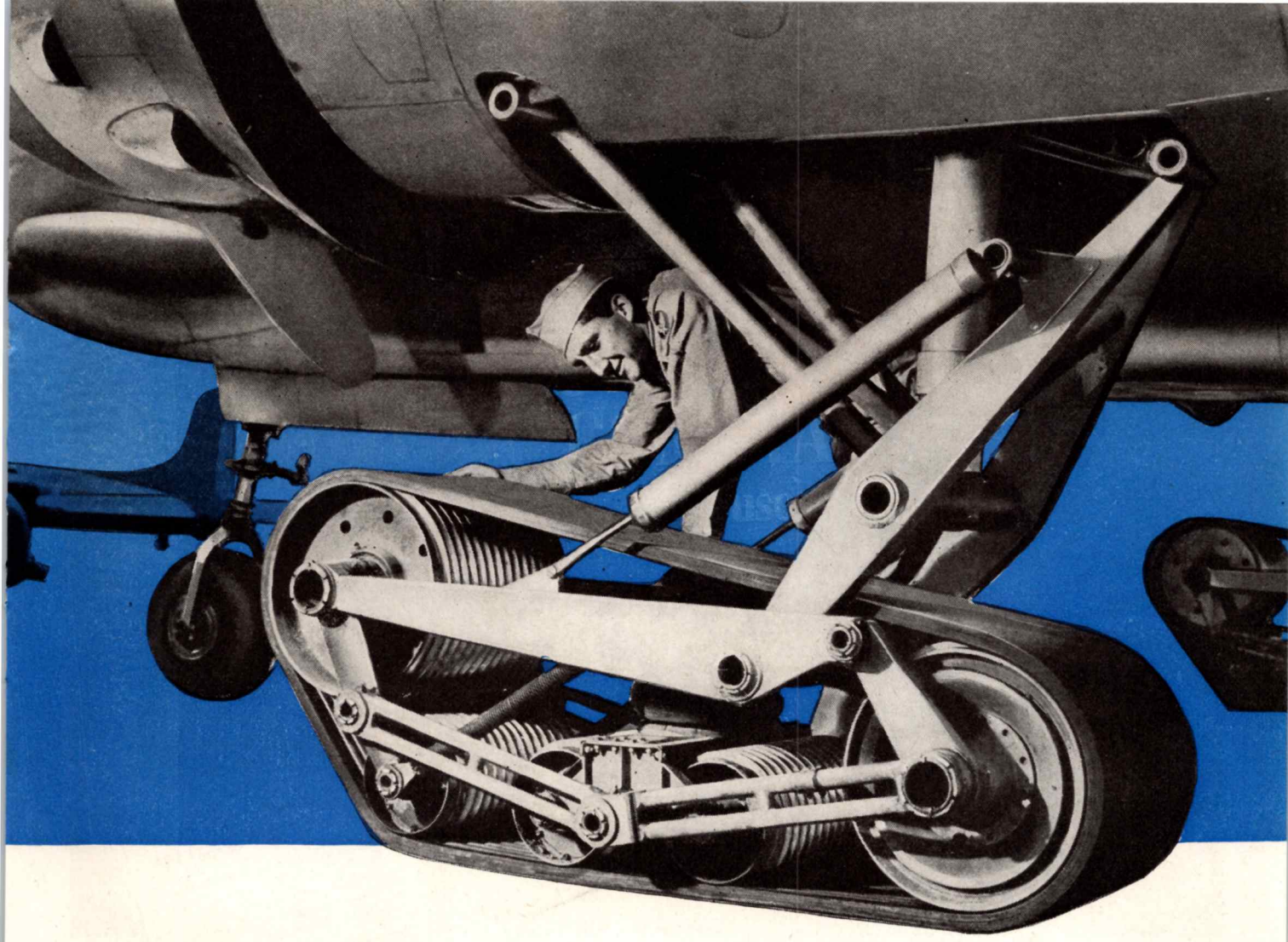
- *When the Airloc is locked, it stays locked.*
- *When the Airloc is unlocked, they can see it a dozen feet away.*

Thus the Airloc fastener, primarily designed for safety in the air, has demonstrated to the men on the service end that cowling, access doors and inspection plates can be checked at a glance. Inspection time is saved. And the risk that cowling will tear loose at high speeds — due to faulty locking — is eliminated. Write for illustrated Airloc folder. Address Dept. D-9.

UNITED-CARR FASTENER CORP.
CAMBRIDGE, MASSACHUSETTS

THE DOT LINE FOR FASTENERS

The Airloc is one of many fasteners we make for the armed services



Safe shoes for sky ships—

Even with the best handling, the big bombers sometimes break concrete runways as they come down. Safe landing has been a problem that kept larger and heavier planes on the drafting boards . . . a problem solved by this radical new type track landing gear developed by HUB INDUSTRIES, INC., in collaboration with the Firestone Aircraft Company and the U.S. Army Aircraft Laboratory.

With a wide web like a tank tread, this new type of landing gear provides a much greater landing area than comparable tire and wheel equipment. Both vertical and directional impact is dissipated by the large *Levered-Suspension* shock absorber holding the track mechanism, and a second set of shock absorbers within the mechanism. Flight tested at Dayton, it has set down the test ship safely at speeds up to 120 miles per hour on rough terrain, sand and soft ground. Retractable, it will weigh less than the multiple tires it will replace . . . and hundred tons-plus planes will land and take off anywhere in safety without special runways—with the HUB-FIRESTONE track landing gear.

Specialists in hydraulics, all present HUB production is restricted to military contracts, but HUB research, engineering and development already have much to contribute to peacetime aviation and industry.

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INDUSTRIES, INC. LONG ISLAND CITY · NEW YORK

formerly DOWTY EQUIPMENT CORPORATION

SPECIALISTS IN HYDRAULIC EQUIPMENT FOR AIRCRAFT AND INDUSTRY

As each brilliant new chapter in aviation history is written by courageous fliers of the United Nations, the aviation industry can well take pride in having contributed to their success.

The superb flying equipment rolling off American production lines is backed by the ingenuity and experience recruited from numerous peacetime industries. Today, one of these, Emerson-Electric, is devoting its 53-year experience in manufacturing precision-built motors to this highly important work.

Keep 'em flying — full speed ahead to Victory!

THE EMERSON ELECTRIC MFG. CO.
SAINT LOUIS . . . *Branches:* New York • Detroit • Chicago
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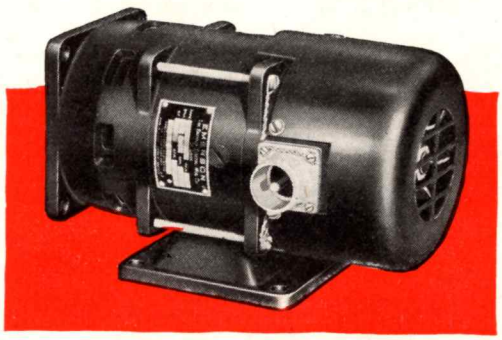


LIGHTWEIGHT • COMPACT • POWERFUL
Emerson-Electric Aircraft Motors are made for gun turret drives, hydraulic units, fuel pumps, actuators, winterizing units, communicating systems, RADAR equipment—also with built-in gear, and magnetic brake.

Emerson-Electric is now engaged 100% in the production of equipment for the Armed Forces.

EMERSON ELECTRIC

324

MOTORS • FANS • APPLIANCES • A. C. ARC WELDERS

The Birdmen's Perch

We're in love!

Lately we've done a heap of traveling. The Gulfhawk has left tire-prints on Army runways all over the country. And that's where we met this dream girl—at Army airports.

She's wonderful! . . . and her name is WAC.

At some busy Service fields she was in the tower and got us in with such crisp efficiency that we felt like the only plane in the area. At other fields she did the weather work—and when she said our destination would be "open" at our ETA, it *was* open. And once she fixed a sick oil pressure gauge in almost less time than it takes to write about it!

We knew that our dream girl was releasing men for combat duty. But at one base, the CO told us that on some jobs a Wac replaced *two or three men!*

We're awfully proud of our girl. And if you've a sister or daughter who wants to give a hand to winning the war, take our word for it, pilot—*she can't beat the WAC!*

Major Al Williams,
alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

THEY HANDLE JEEPS THE WAY AL AND I HANDLE THE GULFHAWK!

HE DIDN'T USE RADIO, EITHER—

When the only clock in his house (and the only timepiece he owned) ran down, a certain Perch Pilot didn't even say, "Pshaw." For Perch Pilots are made of Stern Stuff and have Pure Hearts to boot!

Instead, this bucko walked out to the local airport, sat around "flying the chair" a while, and returned home—where he set his clock correctly! Can you tell how?

We can. We will, in fact, if you ask us!

ABOUT EARDRUMS AND OILDRUMS

Have you ever asked ATC for approval of a flight plan change and heard this reply:

"CRASH ! ! ! ‡*?&*& BOOM ! ! TO CRUISE AT BANG!! CRACKLE # &** # GO AHEAD" . . .

Well, there's a gadget called the "radio static neutralizer" which private pilots will be able to get after the war (military fliers are getting them now) that eliminates static electricity from your reception . . . actually putting it to useful work.

We're not allowed to describe this "eliminator" very clearly—we can only tell you what it does. But we *can* tell you plenty about another "eliminator" . . . the Alchlor Process.

That's the method we use in refining Gulfpride Motor Oil, the world's finest motor oil. In effect, the Alchlor Process is an *extra* refining step which eliminates *more* of the carbon-making and sludge-forming molecules, and actually rearranges other molecules in Gulfpride to make them do more work.

Understand?

TNT FOR TWO

A war ago, nearly all the toluene (that's the last "T" in TNT) used in explosives came from the coal-tar industry.

But today a greater portion of the toluene for ordnance centers comes from the nation's oil refineries. And recently, Gulf put a brand-new unit into the production of toluene at the request of the Army Ordnance Dept.

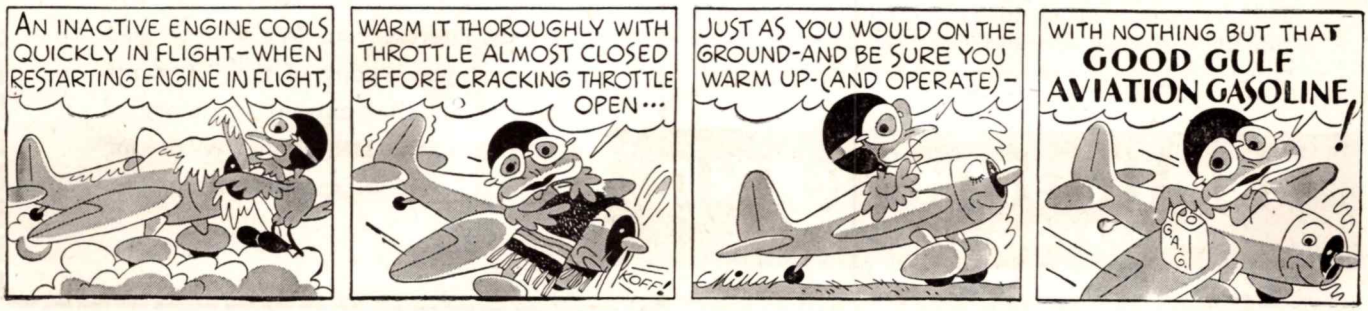
This new unit, strategically located on the eastern seaboard, was constructed 100% with Gulf funds, too.

In short, Gulf has now gone into the business of making pre-fabricated bomb-holes for Berlin and Tokyo!

Gulf Oil Corporation and Gulf Refining Company . . . makers of

GULF AVIATION PRODUCTS

OIL IS AMMUNITION—USE IT WISELY

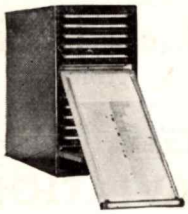


AIRACOBRAS ON *SCHEDULE!*

with

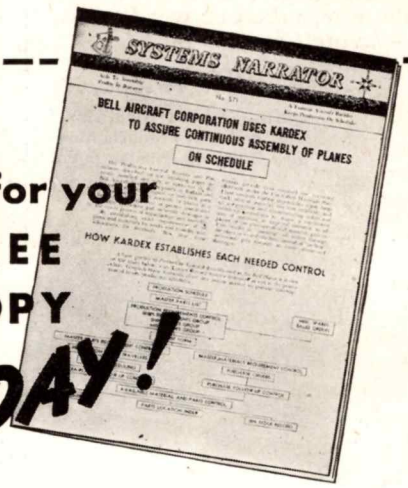
KARDEX

Parts for assembly production at both Bell plants are efficiently controlled with KARDEX Visible Index Systems



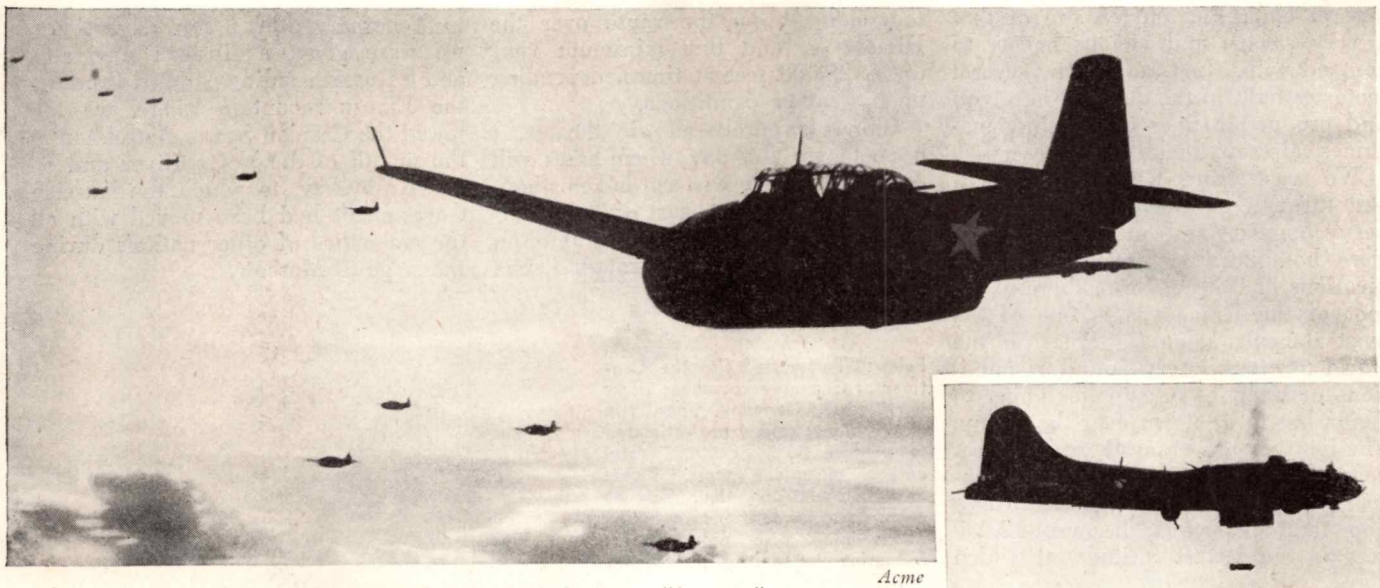
On many fighting fronts Bell Airacobras are giving good account of themselves. It takes three things to deliver those planes where they'll do the Axis the most damage: willing War Workers, wise management and . . . *100% Efficiency!* Control is the heart of the assembly line . . . overstocks, understocks, errors and delays are dangerous. At Bell's Buffalo and Niagara plants, Kardex Production Control Records maintain Assembly Parts at a balanced, effective level. This allows continuous assembly operations and eliminates disastrous shortages in the *entire* production program.

REMINGTON RAND
BUFFALO 3, NEW YORK



Send for your FREE COPY *TODAY!*

Here is a "success story" that will surely interest you. We will be glad to send you a copy of the "Systems Narrator" that carries the story of Kardex at the Bell Plants. Write for it *today*. No obligation. of course.



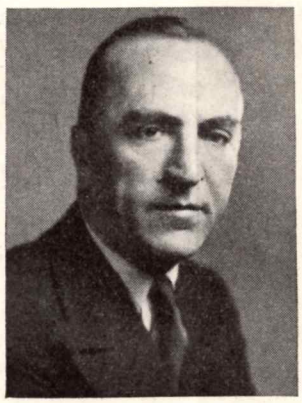
Acme

Part of bombing force of one hundred Grumman "Avengers" which helped soften up the Jap-held Munda airport

"Fortress" drops its eggs over Axis installations in Mediterranean area

This War is not over

CAPT. EDDIE RICKENBACKER



● Having recently returned from a visit to all fighting fronts where Americans are engaged — a trip embracing South America, North Africa, Algiers, Libya, Egypt, India, China and Russia on the way out, and Persia, Egypt, Tunis, England, Iceland, Greenland and Labrador on the way home—I shall brief the highlights of this adventure which covered a period of three months and seven days, involved over 300 hours of flying time, and carried me approximately 55,000 miles over oceans, mountains and deserts.

The itinerary of this, my third mission for Mr. Stimson, our Secretary of War—the first having embraced England, Iceland and Scotland early last Fall, and the second, the Pacific mission in November and December of 1942—must make it evident to all that our fighting men on the ground, in the air, on the high seas and under them are scattered to the four corners of the world.

Leaving Miami last April 29th, we proceeded to Natal, Brazil, and then we jumped direct to Dakar. The mixed passenger list was rather paradoxical to me. Here were a couple of generals and some civilian technicians, but along with them these privates and corporals, gunners and navigators, crew chiefs and bombardiers, a happy lot of kids headed to the hell of war in a big luxury liner at 200 miles an hour.

We zig-zagged our way through Libya and Egypt, saw the 9th Air Force, and visited with our heavies who were bombing from Bengazi and Libya. In this area there is some semblance of civilization and cultivation, whereas out in the Southwest Pacific there is nothing at all but jungles and

vermin and filth, and on top of that a very savage and vicious enemy to contend with. In Cairo I saw several factories built in the desert, where you find production lines overhauling machines, aircraft, tanks and trucks.

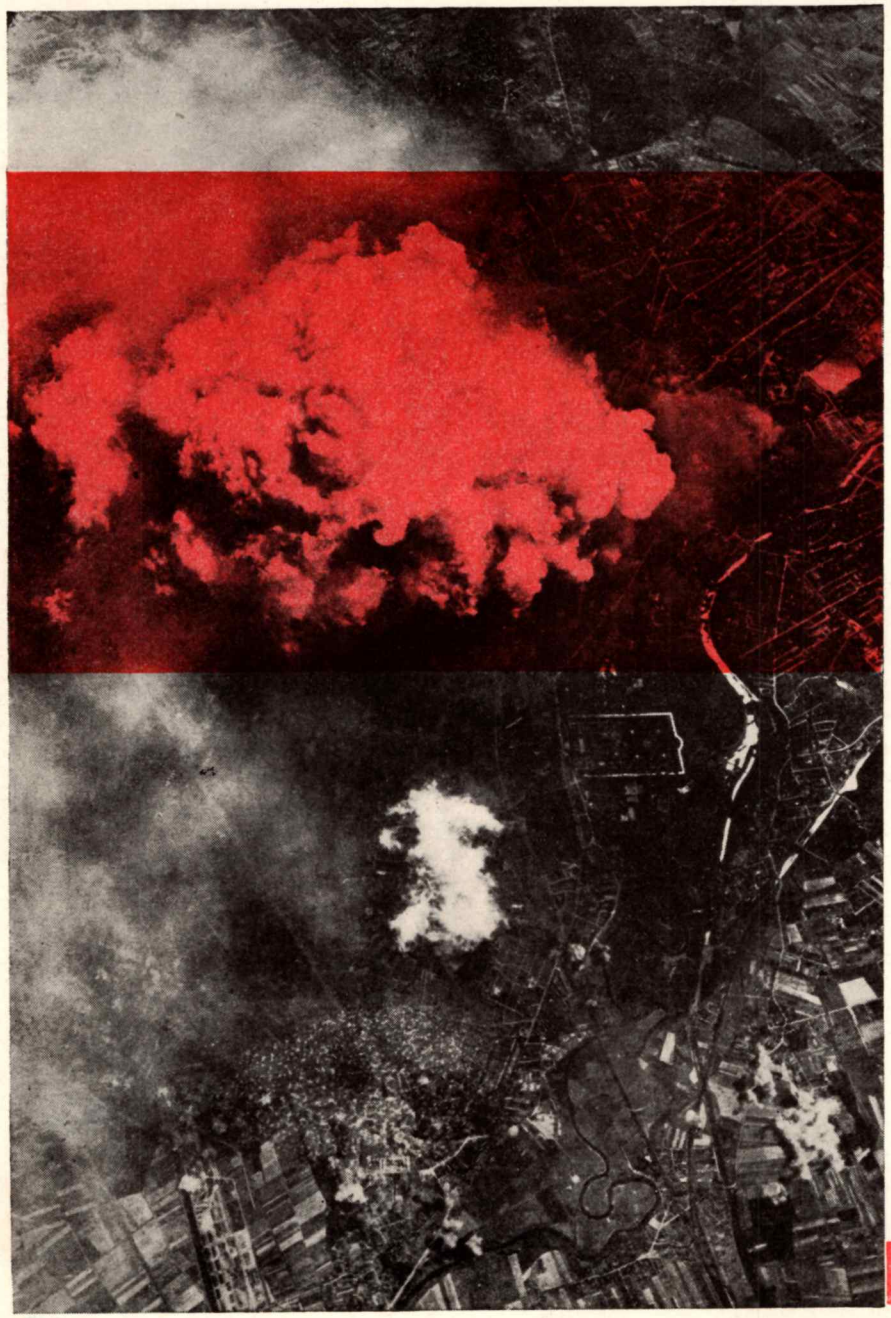
We went from Egypt to Karachi and through to Calcutta, visiting our heavy bombers and our mediums that were bombing the Japanese communications in Burma. From there to the foot of the Himalayas is one of the most difficult mountain areas in the world to cross. Every pound of munitions or weapons or supplies going to China has to be flown over the Hump. The job they are doing there is a great compliment to the air transport command and to the domestic airlines and their personnel, because 12,000 feet is the lowest altitude at which they can fly on the route over the Himalayas, and this minimum runs up to 25,000 feet at times, depending upon weather conditions.

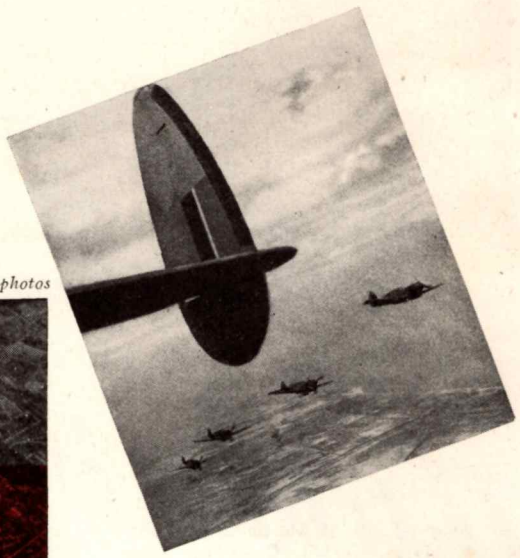
China is purely an air theater. I hope to see the day when bases will be established in eastern and northern China to get at the heart of Tokyo.

We came back across the Hump, on to Karachi and direct through Persia to Teheran. After a few days there, we were given a Russian navigator and a Russian radio operator. Crossing the Elburz mountain range, we followed the Caspian Sea to Astrakhan at the mouth of the Volga River and on to Kuibyshev, to which the Russian Government had been moved with all the embassies of other nations during the siege of Moscow.

Below: "Fortresses" fire the Continental Gummiwerke rubber works in Hanover, Germany, where two of the plants raided are estimated to produce 80% of Nazis' total output of plane tires. Right: "Kittybombers" on their way to attack enemy positions in Sicily, where they also provided information on enemy movements

Acme photos



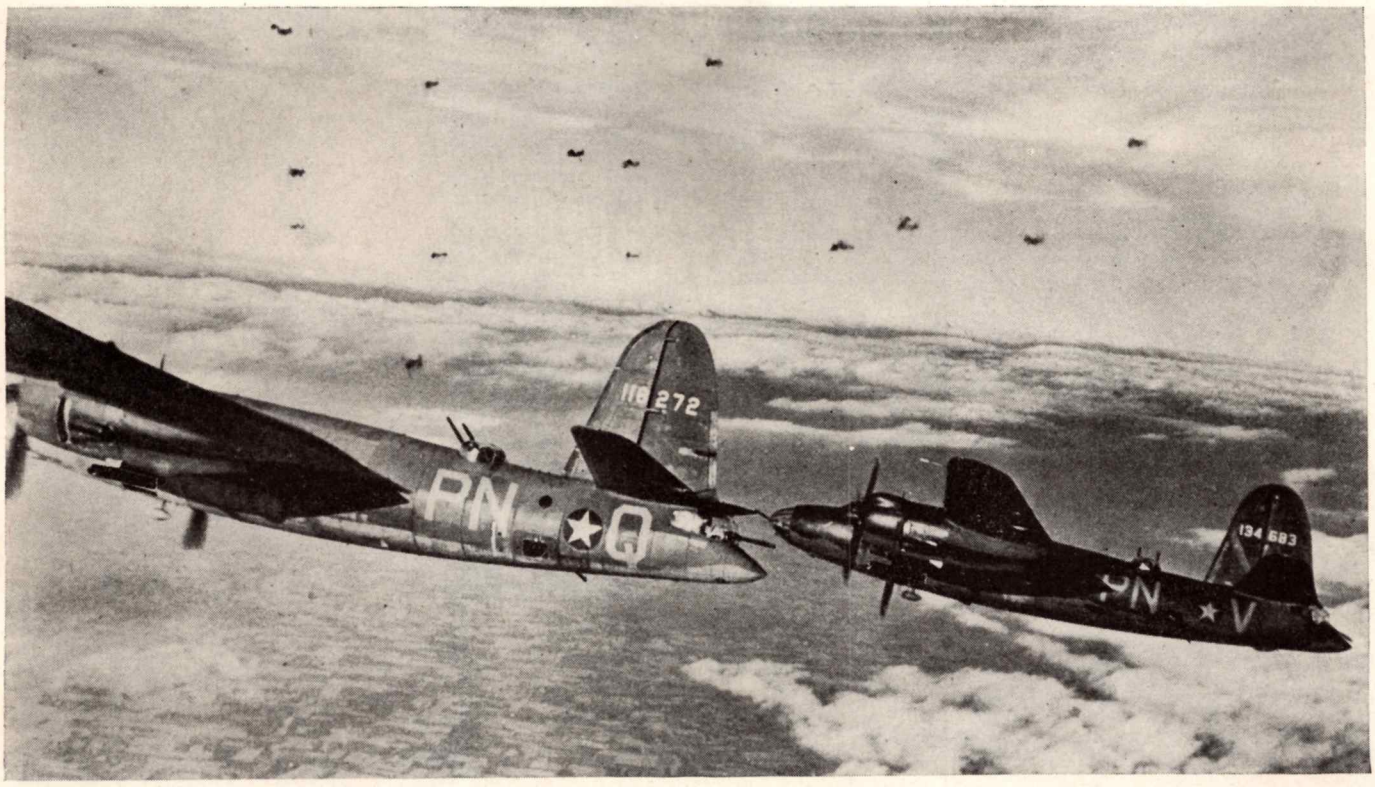


I asked to go to the front and they gave me an American-made DC-3 and five fighters as escort. I landed in the Orel sector. I slept and ate with the boys flying the American-made A-20's and the *Airacobra*.

German Pilots Deteriorating

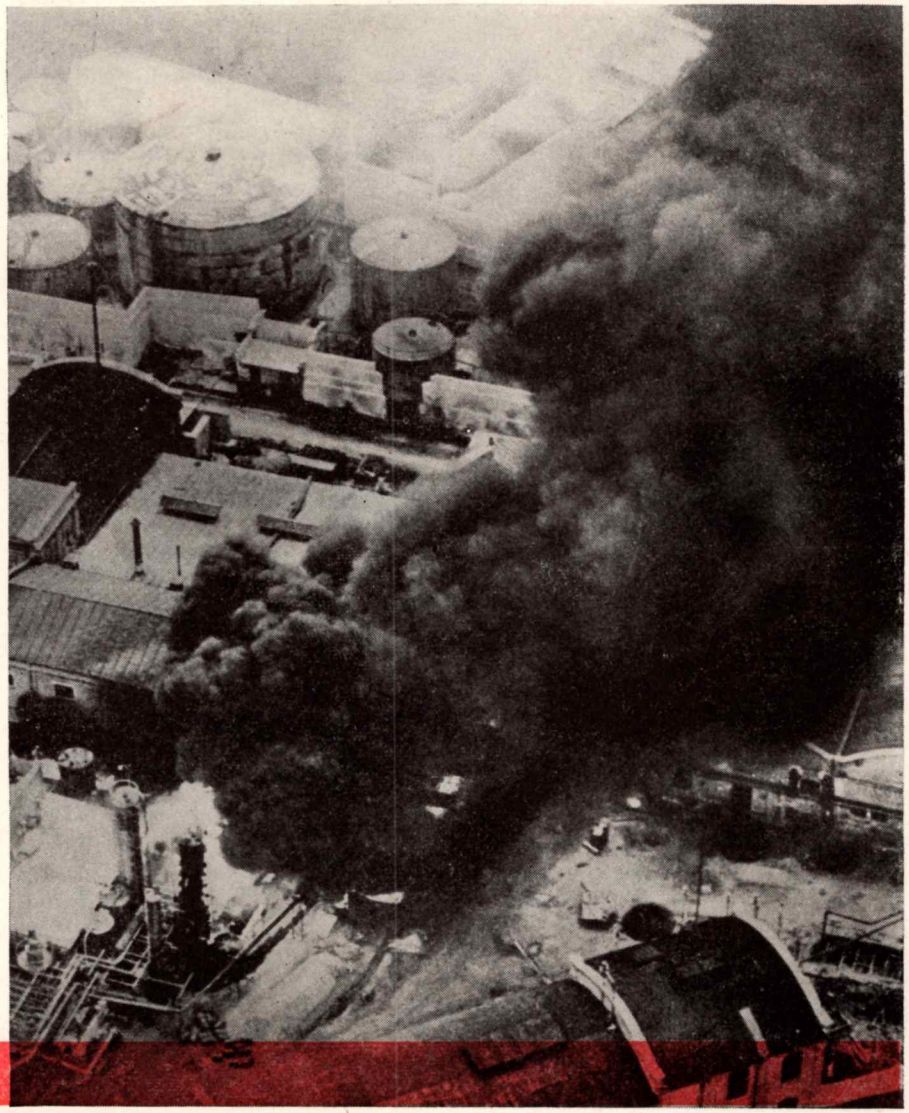
One point I was particularly interested in was whether they had seen any change in the experience level of the German fighter pilots on the Russian front. They said yes, definitely. I asked for how long, and they replied, for the last six months. The Germans, they said, had taken the good flyers from the Russian Front, having called for volunteers to get the spirited few, and sent them to the Western Front.

The pilots told me the Germans had thrown more tanks into a certain recent offensive than they had ever put into any one German offensive since the war started. I visited with a group using the Stormovik tank-busting plane. I was invited to go to the Stormovik factory and permitted to sit in the gunner's seat. I sat there while they fired the two 37-mm cannon into the range pit. The ship is armored. I also witnessed a demonstration of the plane's flying qualifications, given by their chief test pilot.



Acme Photos

Above: Force of Martin "Marauders" in action over St. Omer-Fort Rouge Airdrome in occupied France. Right: Flames consume the distillation plant and other structures of the Steaua Romana refinery, 20 miles northwest of Ploesti, Rumania, after low level attack by Consolidated "Liberators"



"How about your absenteeism problem?" They couldn't understand what I meant by absenteeism. They said: "We don't have that problem, because twenty minutes late is the limit. Workers are reprimanded for tardiness, and if it is chronic, the trial board of employees holds court. If guilty, it means a cut in wages. If lateness continues, the next cut is food, or the ration card. If it is a flagrant case, the man is fired; he can't get a job and is automatically placed on the breadline."

Employees Largely Women

In this plant like most others, 67% of the employees are women and approximately 25% are boys from fourteen to eighteen years of age, as when they become eighteen and are physically fit, they automatically go into the Army, regardless of other qualifications. The balance are men of different ages—each highly specialized in a certain technique.

We came back through Persia into Cairo, thence up to Tunis, landing

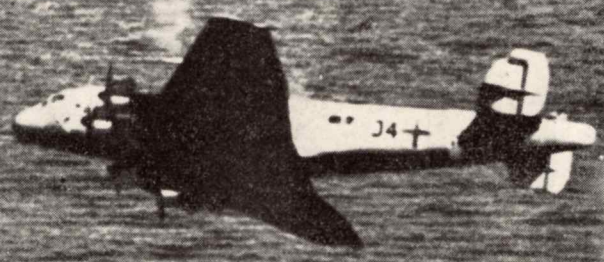
there the day the boys got back from the Rome bombing. There again we had untold superiority. In England, I visited many of our bomber groups and I talked to the enlisted personnel and the combat crews and fighters—everybody. They were super-enthusiastic. In spite of what seem to be extraordinary losses, these are not unreasonable, considering the terrible havoc and damage the RAF is doing now.

We left England after two weeks and went to Iceland. The boys have improved the conditions there tremendously. The same with Greenland.

Evaluation of the Various War Fronts

As I have evaluated the fronts that I have visited, and I have visited all of them in the world except the Aleutian Islands, I would take the Southwest Pacific as the most difficult. I would put it as primarily an Air, then Navy and then Army theater. I would put the Aleutians next; they are the opposite side of the fence from the tropics. It is primarily an Air theater, then Navy and Army. Third, I would say the Russian Front, basically due to the fact that they have two-thirds of the German Army opposing them on their own soil. That is an Army and Air front.

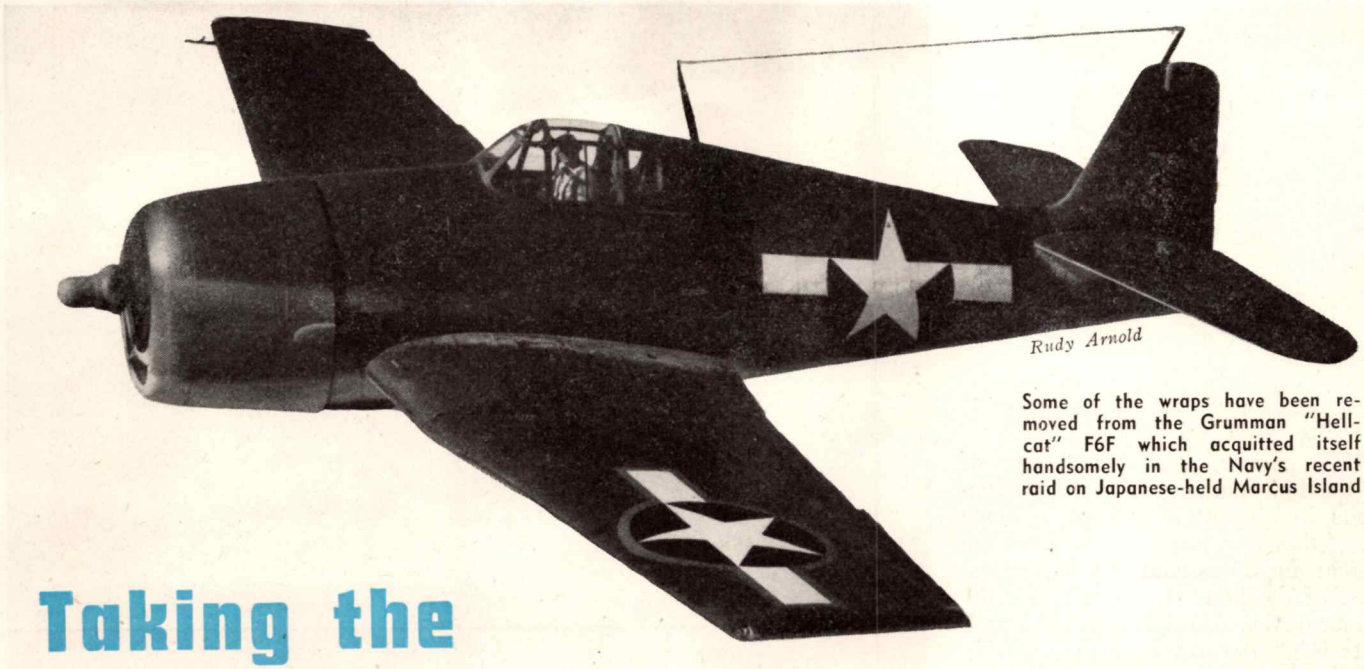
The Chinese Front is down the line,



Imminent watery end of a JU 90, the victim of RAF "Marauders" off the coast of Corsica

difficult because it is on the end of the supply routes and 20,000 to 25,000 miles away, but it is primarily Air. The Mediterranean is primarily Air and equally divided between Army and Navy on the surface. England is outstandingly Air; eventually Army, or Army and Navy combined.

In recognizing that the war is a long way from being won, that we will have untold casualties—the real casualties haven't started to come in yet—we must remember that after the European situation cracks, we will have another year or more of war with a vicious, savage enemy in the Pacific, which will be settled primarily by air and seapower.



Rudy Arnold

Some of the wraps have been removed from the Grumman "Hellcat" F6F which acquitted itself handsomely in the Navy's recent raid on Japanese-held Marcus Island

Taking the MEASURE OF AXIS AIR POWER

● In his biennial report to the Secretary of War, Chief of Staff Gen. George C. Marshall says of the Army Air Forces: "They are now attacking the enemy on ten different fronts throughout the world, and their victories . . . testify to the gallantry and skill of the pilots and crews, to the mechanical efficiency of planes, and to the leadership of Gen. Arnold and the fighting commanders of the air forces in the field."

Down in the South Pacific the box score has been approximately 20 to 1; in North Africa it was about 18 to 1; over Europe it is at least 4 to 1.

Added firepower in both our bombers and fighters, increased speed, greater range, greater maneuverability of fighters—all these have resulted from battle experience.

Bombers Get More Guns

The *Liberator* now has a nose turret; the *Fortress* has been fitted with .50 cal nose guns; the *Mustang* now carries four 20 mm cannon in its wings, to mention but a few of the individual plane modifications contributing to the increased ability of our air forces to dish it out.

Latest fighting fool to be partially unveiled is the Grumman *Hellcat*. Although it has been in production for some months, it is only now that some meagre information about it can be published. This *Hellcat* lives up to its name, the Navy indicates, revealing that it was in action in the raid on Japanese-held Marcus Island on September 1st.

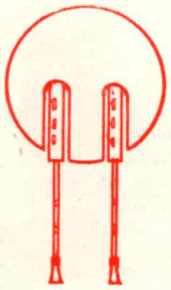
The *Hellcat's* model designation is F6F and many of the features of its construction, it is said, result from the experience of combat pilots, making it strictly a wartime design. It is credited with high maneuverability and exceptional speed, and according to Navy pilots, it out-performs the *Wildcat* which has no mean record itself, with a ratio of about 10 to 1 superiority over the enemy.

The *Hellcat* offers the pilot the same protection as to armor and armament as the *Wildcat*, with added speed, maneuverability and increased rate of climb which enables it to "out-zero" the *Zero*, according to the Navy. The plane is powered by a Pratt & Whitney engine. For security reasons, data concerning actual speed, horsepower and rate of climb remain restricted.

The new plane roughly resembles the *Wildcat*, with characteristic square wing tips and hydraulically-operated folding wings for shipboard storage. A high degree of visibility is attained by having the engine cowling sloped down to allow the pilot to see over the nose in aiming his guns. As in the case of the *Wildcat*, the pilot's cabin is located at the largest diameter of the fuselage, thus placing the pilot at the most advantageous point for best visibility.

Wrecked Jap aircraft are a familiar sight in the South Pacific theater, where the box score is about 20 to 1. Attrition has already blighted Nipponese air power

Acme



POWER TURRET GIVES

THE powered gun turret, one of the few fundamental new developments in aircraft armament to come out of this war, has revolutionized the tactical functions and the strategical value of the bomber. By relieving the gunner of the well-nigh impossible task of training the ordnance manually in the face of ever-mounting wind resistance at high speeds, and by multiplying the fire power at each station by the addition of more guns, the power turret has made the modern bomber a self-sufficient unit in defense.

Prior to its development, all bombing missions were defended by fighter escort, since the hand-operated guns could not be moved fast enough to fire accurately at speeds of 250 and 300 mph. With power-operated turrets, modern bombers have uniformly defended themselves, with or without escort, in all theaters of war. This elimination of the need for escort planes has so vastly increased the striking range of the bomber as to radically alter all pre-war evaluation of its effectiveness.

Aiming a power-operated turret requires no more effort than the touch of a finger or turn of a wrist. The slightest touch on the controls causes the guns to move in any direction, thus permitting the gunner to concentrate on accuracy of aim and timing of fire. Moreover, these weapons have been extremely effective at high altitudes, where the slightest physical effort causes exaggerated fatigue. Thus, enemy pursuit pilots find themselves running into a stream of heavy-calibre fire, regardless of altitude or direction of approach.

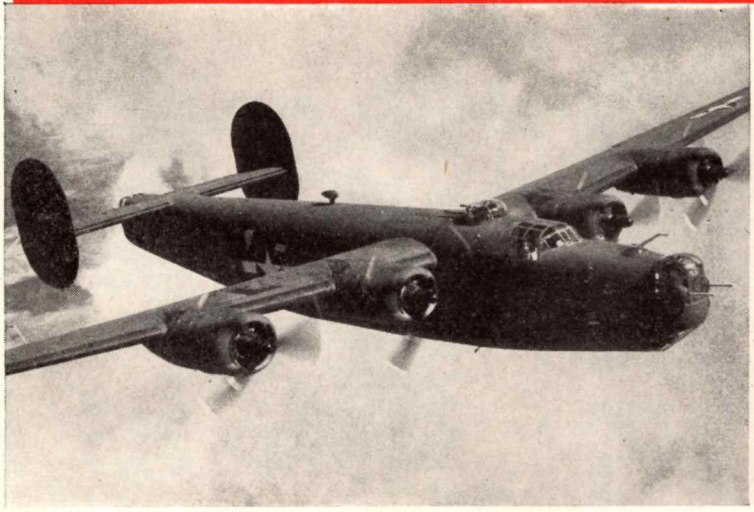
It was some ten years ago—in England—that the first power-operated gun turret was conceived. For at that time the firm of Nash & Thompson, Ltd., which is now the development division of Parnall Aircraft, submitted to the British Air Ministry the first design for a power turret.

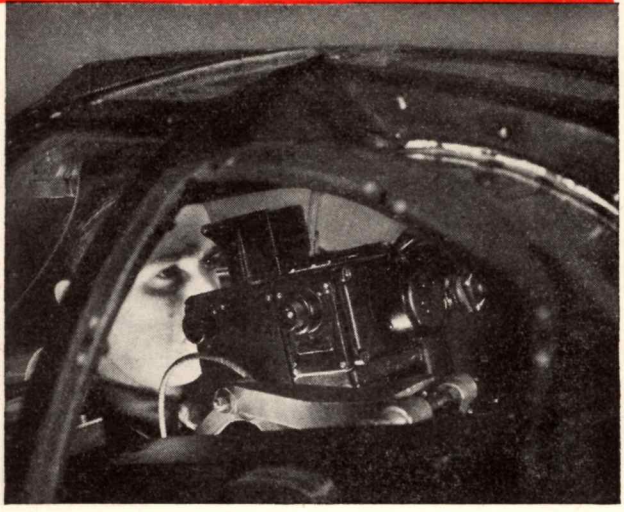
Finesse in Turret Control

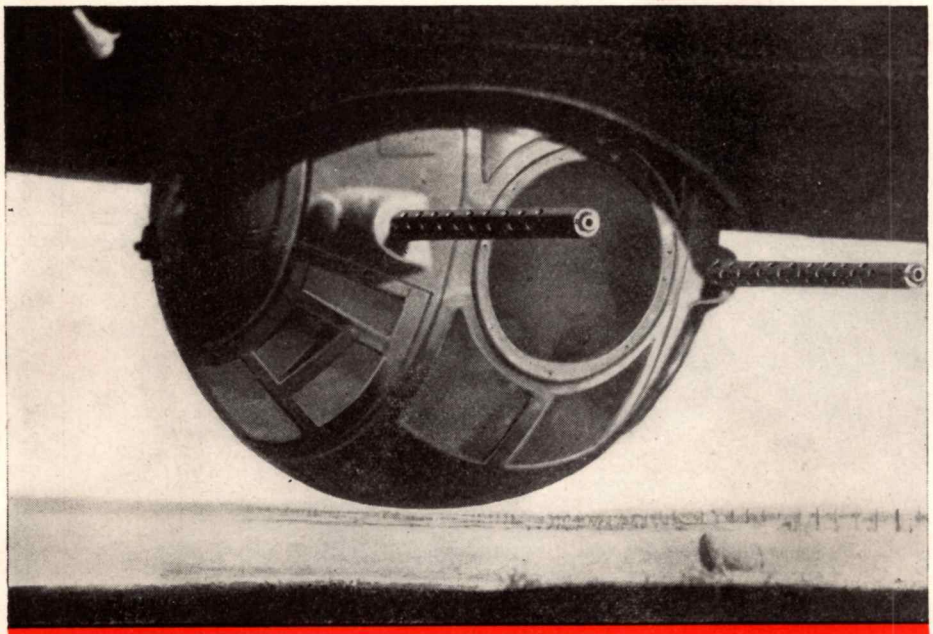
It was adopted as a basic principle from the outset that under the conditions of aerial gunnery, with its physical and mental strain and with the high speeds of reaction necessary,

Left: Consolidated "Liberator" with new Emerson electric nose turret, which allows almost 360° of visibility. The other turrets are located in the tail and belly and atop the fuselage. Right: The "little black box"—a Sperry automatic computing sight installed in "Flying Fortress" turret

Consolidated *Sperry*







Ball turret, embodying Sperry automatic computing sight, installed in the belly of a "Flying Fortress"

OUR BOMBERS THE EDGE

finesse in the control of turret movements was of primary importance. Here, hydraulics lend themselves to sensitive action, and the British developed a form of control which was almost instinctive.

Efficiency in any turret demands the widest possible zone of fire, and it was essential that full rotation should be obtainable. Without it, the gunner would often find it necessary to move the turret through the greater part of a circle in order to traverse it through a small angle, by which time he might be shot down or the enemy be out of range. This became a controlling factor in turret design.

Although the development of this vital weapon became intensified with Britain's entry into war, the basic principles governing its design and construction have remained unchanged since the earliest production models. How it was used with devastating effect by the RAF in the early months of the conflict is a matter of history.

Meanwhile, back in 1937, before the war storm broke, American engineers had likewise built a power turret. The first one, developed by Glenn L. Martin, was designed for use on the Navy's PBM-1 patrol bomber. Since then, there has been constant refinement and today power-operated turrets are being successfully manufactured on a production basis by a number of American companies. Moving assembly lines turn out the turrets with remarkable efficiency. The designs have been so simplified that the numbers of parts have been reduced and the whole mechanism at the same time greatly improved.

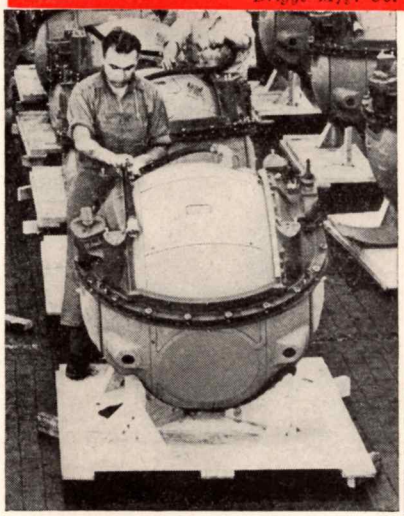
German Designs Frozen

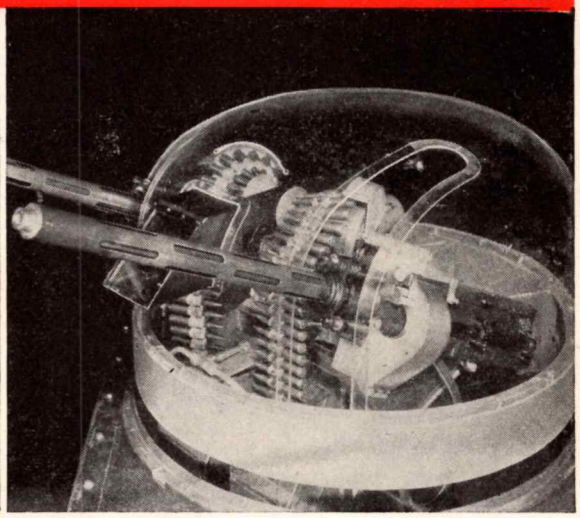
The Luftwaffe's race for quantity since 1939 has frozen so many of the German designs that it has prevented the introduction of this valuable weapon and its development in service. Difficulties in the way of its general adoption by the Nazis at this stage are practically insurmountable. In its light and heavy bombers the Axis is therefore restricted to the use of manually trained guns, limited in calibre, field of fire and range. Accuracy of turret fire also is considerably below the standards attained by the planes of the United Nations—particularly since the advent of the automatic computing sight.

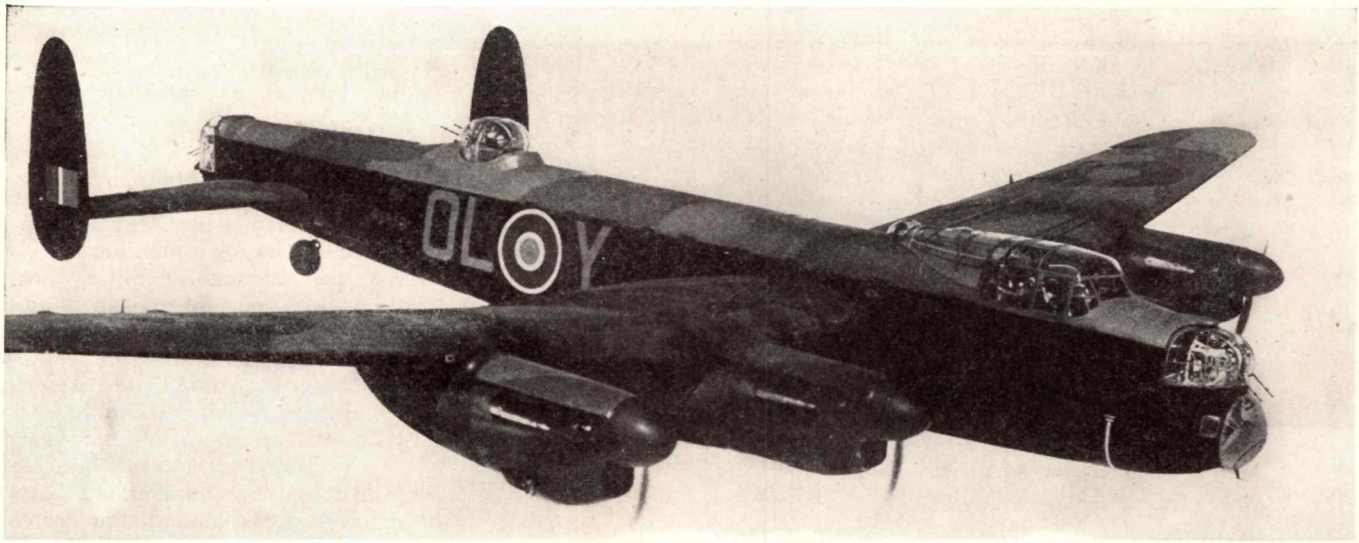
Our rise in the power-operated turret field has been swift. Before mass production of turrets could be begun in this country, the design requirements had been changed to provide for two .30 calibre machine guns, working as a unit, to replace the one .30

Left: Early assembly operations on belly turrets for "Fortresses" at plant of Briggs Mfg. Co. Center: First turret designed with "Plexiglas" shell, 1937. Right: Turret, with "Plexiglas" sections ready for installation in North American "Mitchell" medium bomber

Briggs Mfg. Co. *Rohm & Haas*







The Avro "Lancaster." This British bomber's armament includes ten turret-mounted machine guns

calibre weapon originally prescribed. Then, with Europe at war, reports from the front caused our military authorities to call for larger calibre weapons. It was indicated that the solution would be in a turret housing a single .50 calibre gun, the turret to be power-operated in azimuth, thus balancing at least part of the air resistance. The gun was still to be elevated and depressed manually.

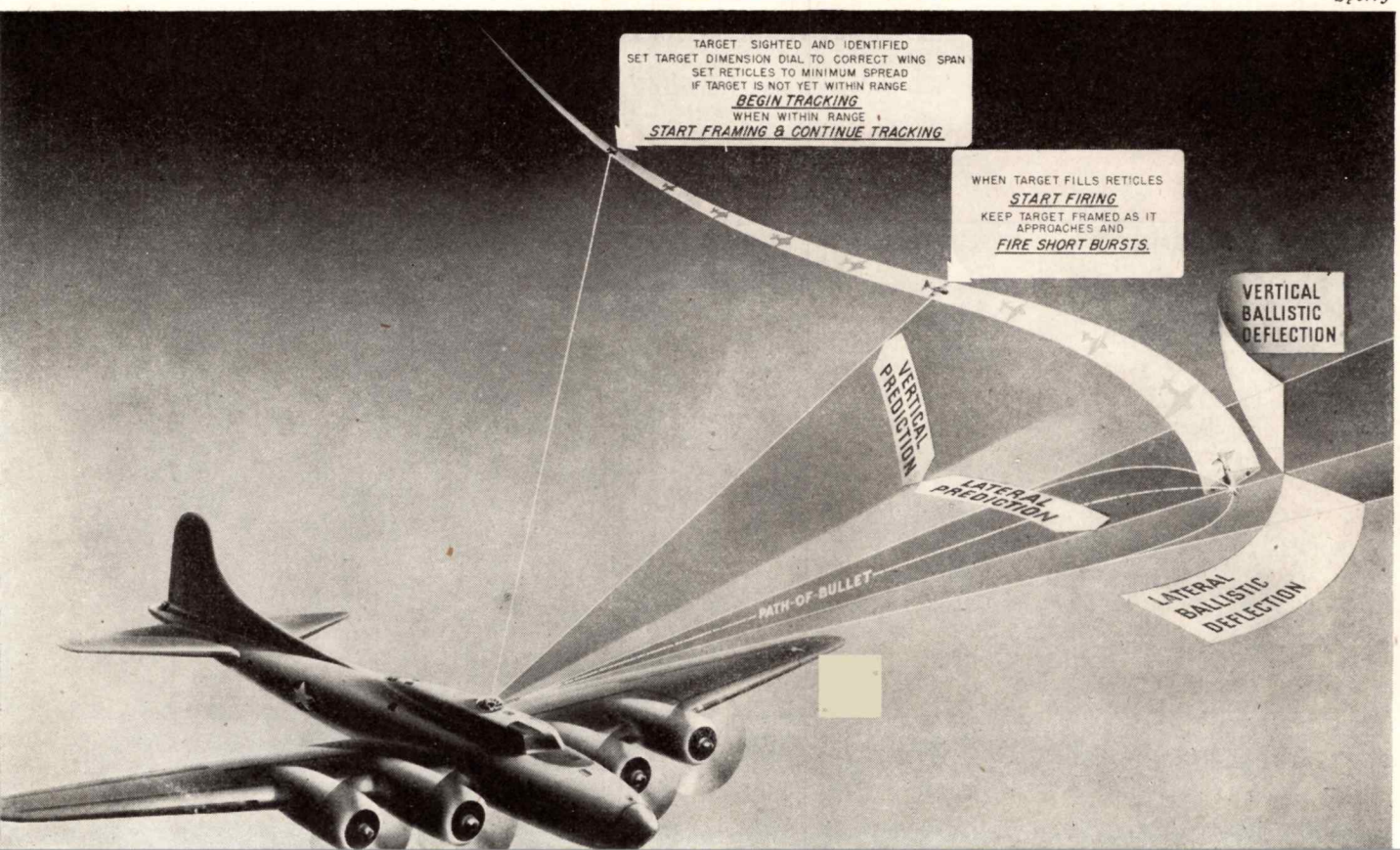
When Lieut. Gen. H. H. Arnold, chief of the Army Air Forces, issued his famous "must" list in the spring of 1940, power-operated turrets was one of the topmost items. The navy already had a power turret on the PBM-1—a hydraulic device mounting one gun. Martin added to this contribution by creating the Army's first power turret. It was featured by two .50 calibre guns operated both horizontally and vertically by electricity, a seat for the gunner, continuous ammunition supply and armor plating to protect the gunner from enemy fire.

As pioneers in the field, Martin engineers introduced several novel production features during this early phase of turret manufacture. One was the casting of the inner ring as a single piece. Another was the one-piece casting of the "chassis" of the turret. All the other parts were now bolted or clamped to the chassis, thus making for ease of assembly. Along with such design simplifications came improved assembly methods, another prime factor in speeding up production. In the Martin assembly, arrangements were made for the first jig to move slowly along a pair of channels in the factory floor, drawing other fixtures behind it in a line. Thus, as each fixture comes to a given station, the crew of that station steps aboard and performs its function, steps off at the end of the station, and walks back to board the fixture next arriving.

Further refinements and innovations were now rapidly forthcoming as other manufacturers, having evolved their own designs, went into production. In July of 1940, the Sperry Gyroscope Co. came out with the first .50 calibre computing sight—an engineering mas-

Diagrammatic representation of operation of Sperry automatic computing gun sight, showing progressive steps in solution of the ballistics problem

Sperry



terpiece which had been perfected, built and delivered all in a period of six months. Hooked up with a hand-held waist gun, it was tested in a series of flights over Lake Erie. A big improvement over earlier devices, it was to give even better results when used in conjunction with a power turret.

The wedding of the precision sight to a smooth operating power turret promptly became an actuality. The Sperry electro-hydraulic control not only relieves the gunner of the physical task of fighting the gun's tendency to align itself with the windstream, but with this turret the gunner cannot riddle his own ship. He keeps his thumb on the button in the knowledge that a burst will be automatically interrupted when any portion of the bomber is in the line of fire. In addition, the design makes possible the mounting of more than one gun per sight.

Sperry Turrets

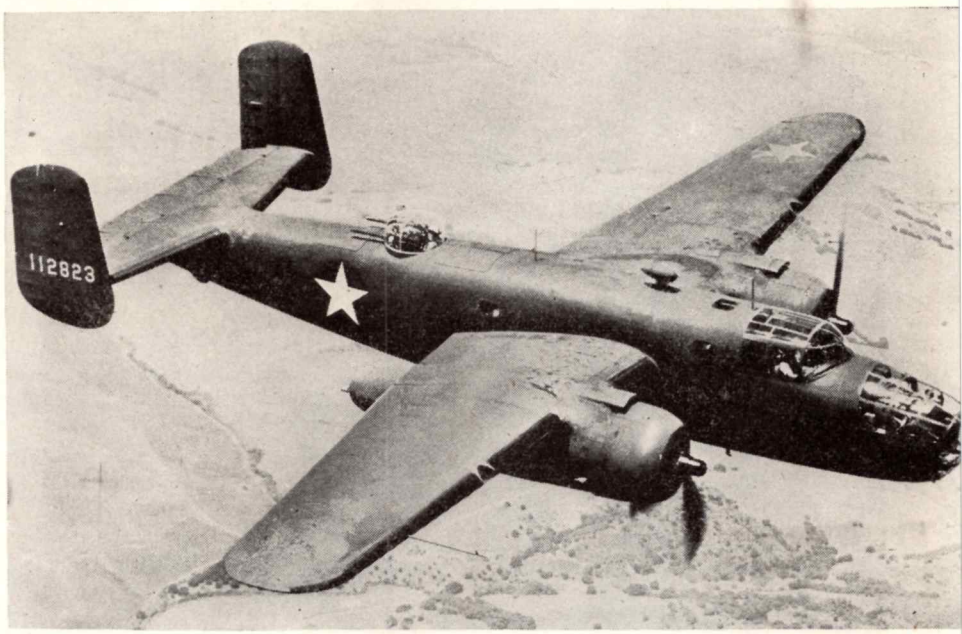
Sperry upper local turrets with the automatic sight were placed atop the fuselage with the start of production of Boeing *Flying Fortresses*. The belly turret was added a short time later. Their manufacture was placed in the hands of Vickers, the Sperry subsidiary, and of the Briggs Manufacturing Co.

The appearance of the new *Fortresses* in the theaters of war changed an Axis habit of long standing. It had been like "shooting fish in a barrel" for enemy attackers to swoop up and pour lead into our bombers' bellies. That has all been changed. The ball turret gunner is master of all he surveys, and he surveys enough to cover the entire underside of the bomber.

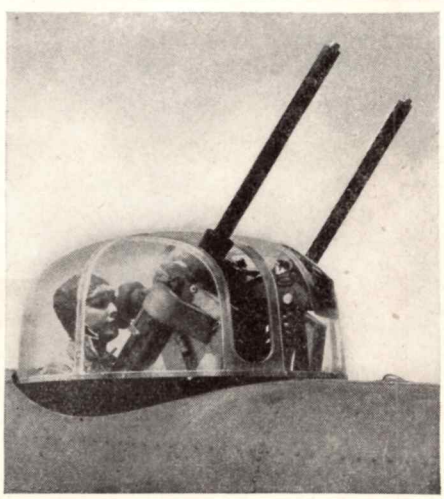
The turret revolves completely, 360° in the horizontal plane at rates up to 48° per second, or five complete revolutions per minute. It describes a 90° arc in elevation. The upper local turret revolves in the horizontal plane only. Manually operated, the guns themselves move in elevation.

Other manufacturers, meantime, were equally active in this field, notably the Emerson Electric Co. and Bendix Aviation Corp. Further features were constantly being introduced. These included mechanical improvements, additional equipment, added comfort and therefore efficiency for the gunner, and the use of substitute materials, such as plastics, to avoid a drain on critical materials. In this connection, Rohm and Haas Co. had come forward, in 1937, with *Plexiglas*, representing a chemical engineering achievement that was soon to become inextricably identified with gun turret construction. Du Pont, with *Lucite*, and Celanese Celluloid Corp., with *Lumarith*, soon entered the field. The lightness, toughness and transparency of this type of material make it ideal for the contoured shell of the turret.

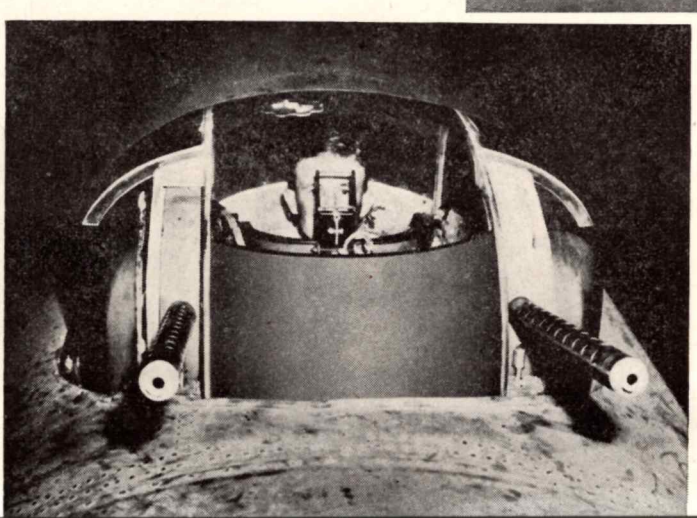
Today as an indication of the special adaptability of the different makes to assignments aboard representative planes, Bendix turrets are a feature of the North American *Mitchell*, Emerson electric and Sperry ball turrets are installed in the Consolidated *Liberator*, and turrets of Martin manufacture include those in its own *Marauder*, in the Vega *Ventura* and in the Douglas *Boston*.



North American "Mitchell" medium bomber, showing disposition of turrets



Rohm & Haas



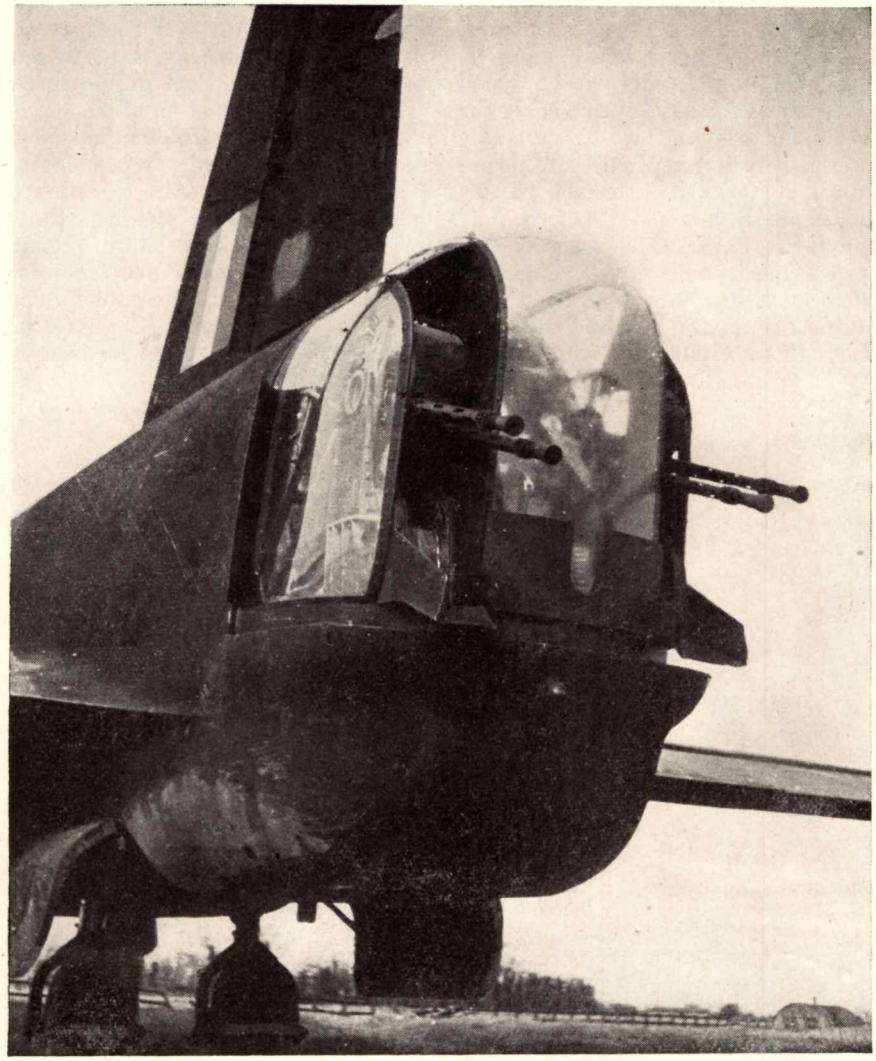
Above: Top gun turret of a "Mitchell" ready for action. Left: Martin turret used in numerous other bombers besides the company's own

Martin

To return to the British episode now, in the absence of releasable corresponding data on American turret construction, the first turret produced by Nash & Thompson, and which was fitted to a Hawker *Demon* biplane nearly a decade ago, is still typical of all the firm's turrets. An important feature is the track ring mounted on the aircraft structure that carries a moving ring to which the components are attached—all the downward, upward and radical loads being taken by ball-bearing rollers which give frictionless running and accurate constraint.

No Backlash

A hydraulic vane motor, mounted on the rotating ring, carries a pinion meshing with a fixed circular rack. Special features ensure freedom from backlash, so that the powered rotation remains accurate even when the guns pass into the position where drag



Above: Frazer-Nash tail turret as installed in a British "Stirling" bomber. Below: Power operated tail gun turret of a "Whitley" bomber, mounting four Browning machine guns

changes from "opposing" to "assisting." This feature is also necessary in holding the guns steady against inertia effects during evasive action. The elevation and depression of the guns, being limited in extent, is effected by simple hydraulic rams. For reasons of rigidity and power these are sometimes duplicated, with one at each side of the gun cradle.

The other main components fitted to this early turret, and indeed to the many thousands made since, are the engine-driven generator pump, the recuperator and the control valve. The recuperator plays an important part besides that of functioning as a header tank, by spring loading the fluid and taking up variations due to expansion and to differential displacement on the two sides of the ram pistons. It further obviates that well-known trouble in certain types of hydraulic systems known as "foaming."

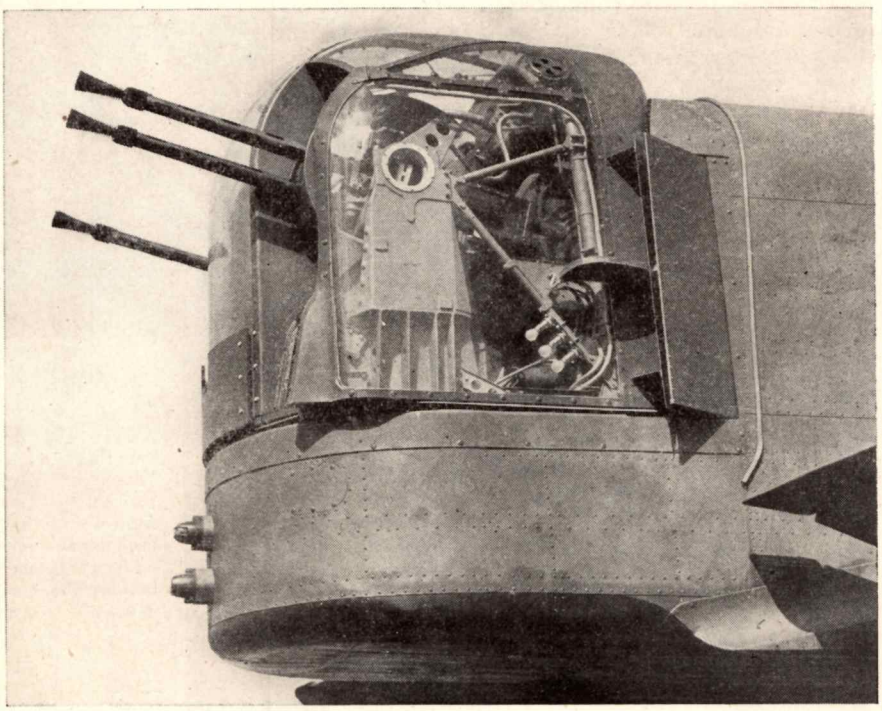
To provide a continuous flow of oil from the generator pump into the turret, with a return path back to the generator pump, a gland is mounted on the vertical center line of the turret. This rotary service joint is also provided with electrical slip-rings for the electrical services and a passage for the oxygen supply.

From this stage the oil is fed to the valve box, which contains three valves, one supplying the rotation motor and one for the hydraulic rams, the third being the master valve operated by hand grips on the control handles. This "dead man's grip," when released, short circuits the hydraulic flow when the turret is not being operated.

Basically Unchanged

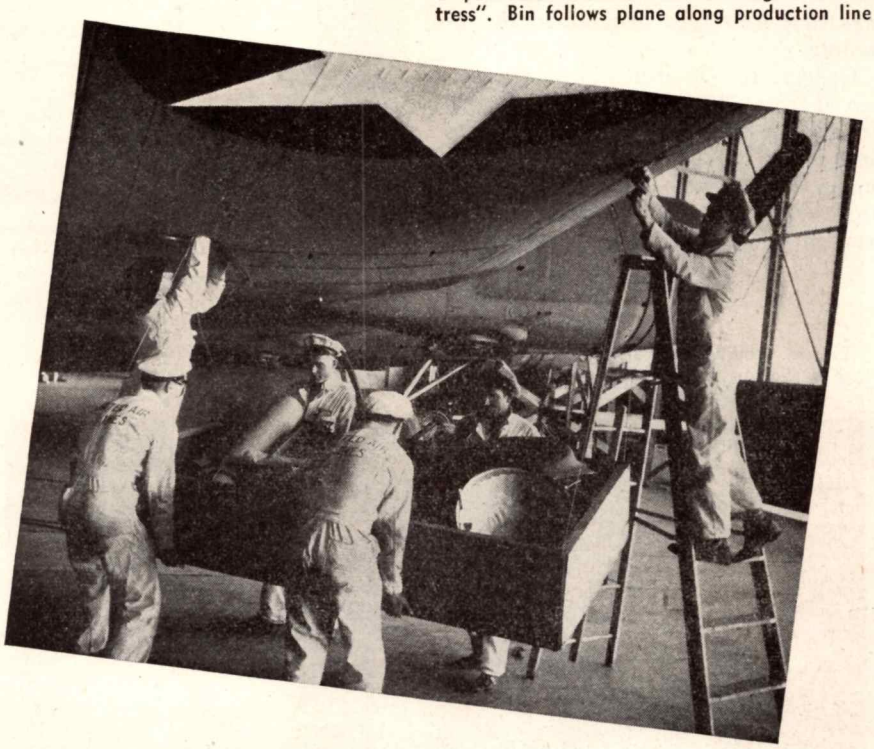
The components and basic layout developed in those early days were so successful that they have remained practically unaltered, but there are many interesting subsidiary features. These include the control port characteristics, the trip gears, sight mechanism, hand rotation gears, mechanism for retracting gun-turrets, emergency hand operating gear, and so forth. These and other developments have attained a high pitch of perfection. A distinctive feature is the specially developed vane-type oil motor for rotating the turret. The gear-type of motor had been tried out but proved erratic at low speeds.

The organization that has grown from the pioneer beginnings of a decade ago, has put fire power into the hands of Britain's *Demons*, *Harrows*, *Whitleys*, *Wellingtons*, *Manchesters*, *Lancasters*, *Sunderlands*, *Stirlings* and *Bothas*. These aircraft have shown how well they can defend themselves.



MODIFICATION CENTERS FIT MILITARY PLANES FOR COMBAT

Attaching bin containing all parts needed for a particular modification to wing of "Fortress". Bin follows plane along production line

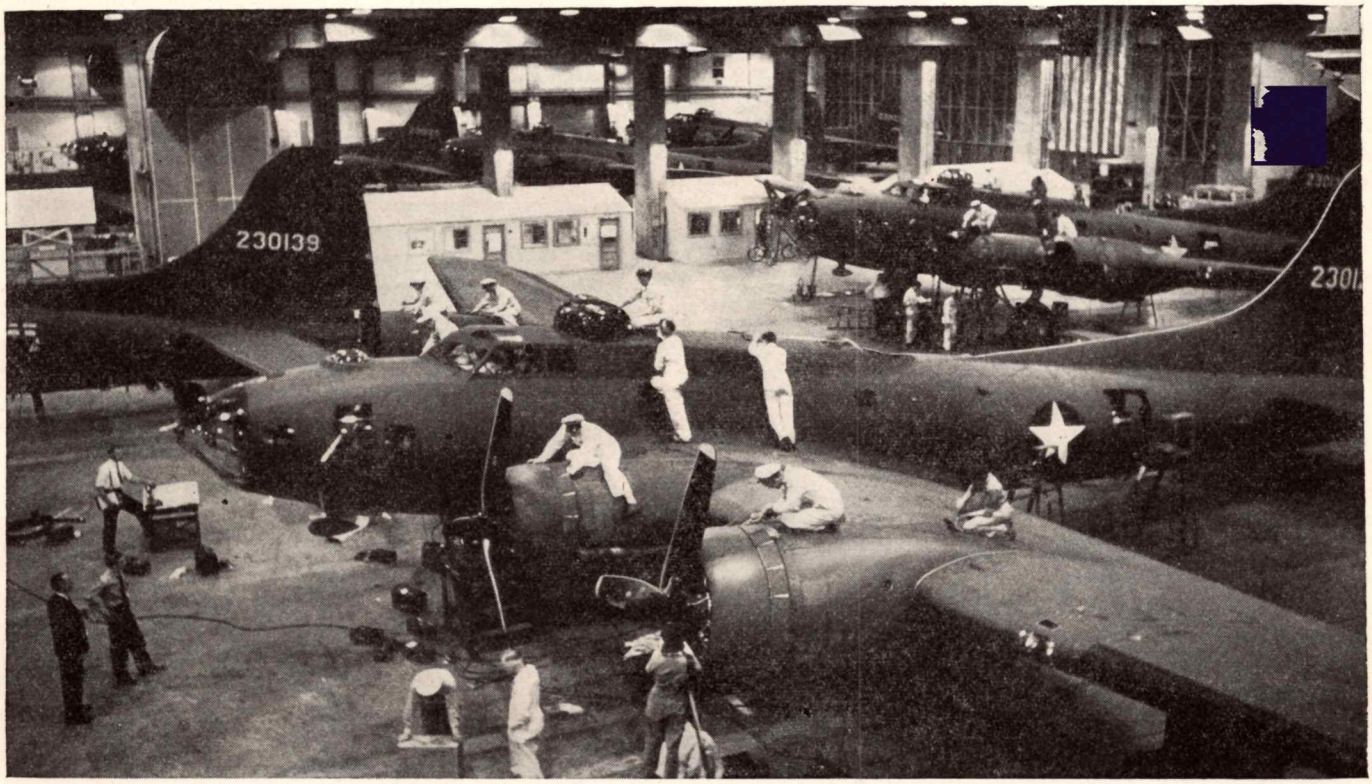


● In supplementing the work of the plane builder by fitting military aircraft to meet the varied and specialized requirements of battle areas the world around, modification centers in this country are performing a vital war service whose scope has steadily been expanding ever since Pearl Harbor.

In December, 1941, military authorities began the dispersal of planes concentrated near factories on the West Coast, where they constituted tempting targets for enemy bombers. Refuges far inland were chosen, and around these the modification centers have grown.

Two of the first to spring into being, those maintained by United Air Lines at Cheyenne, Wyo., and by Consolidated at Tucson, Ariz., are today outstandingly typical of these establishments. Others are located near the various aircraft plants and at strategic points. A huge operation has begun at Atlanta; others in the East are in the Buffalo and Baltimore areas.

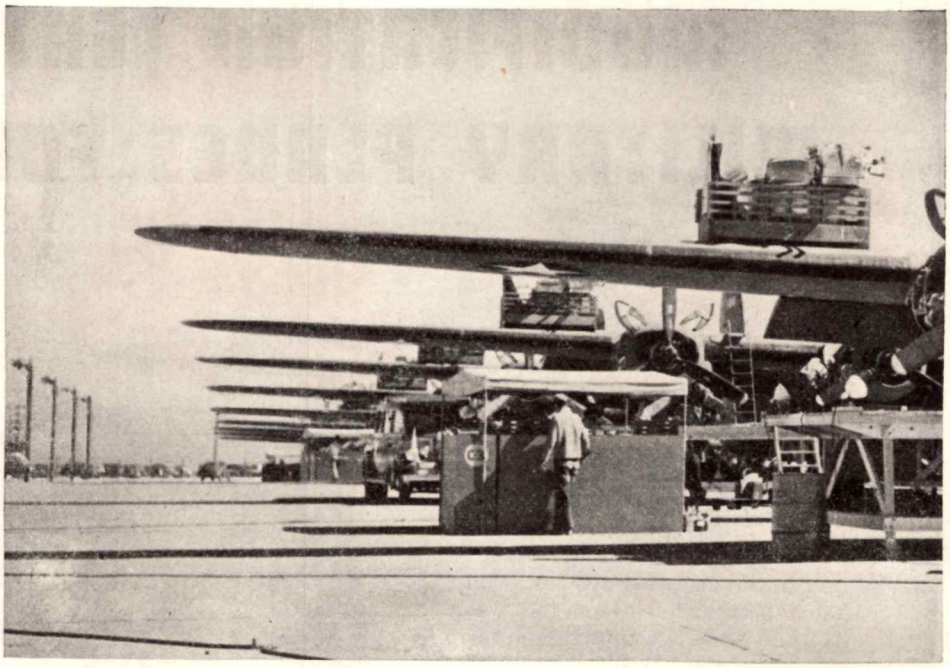
Below: Section of Cheyenne modification center, where bombers undergo alterations in accordance with lessons learned at fighting fronts



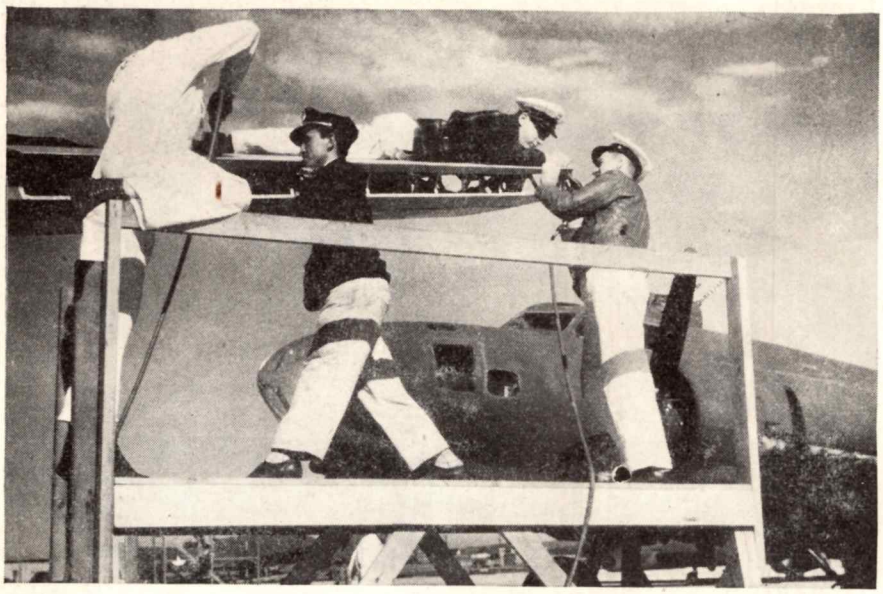
Entirely separate from United's maintenance base there, at which commercial transport planes are overhauled, the Cheyenne modification center is operated under contract for the Army Air Forces.

The main job, as at all such centers, is to make those last-minute installations and changes on military aircraft which could not be incorporated on the assembly line without the inevitable delays that would be occasioned by retooling.

Orders for modifications are received from all fronts by the Army Air Forces' special projects branch at its production division, Materiel Command, Wright Field, Ohio. There they are studied and, if practicable, are forwarded to the modification center handling the model or type of plane involved.



Above, and on facing page: One of the four modification lines for "Liberators", at the Tucson base, where most of the work is done outdoors

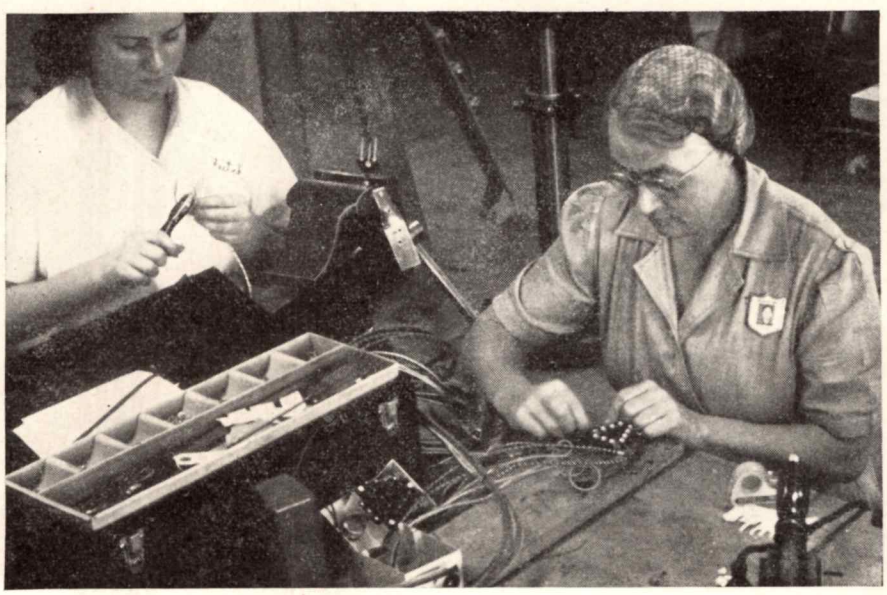


Below: Modifying the aileron hinges of a "Fortress", at the Cheyenne center

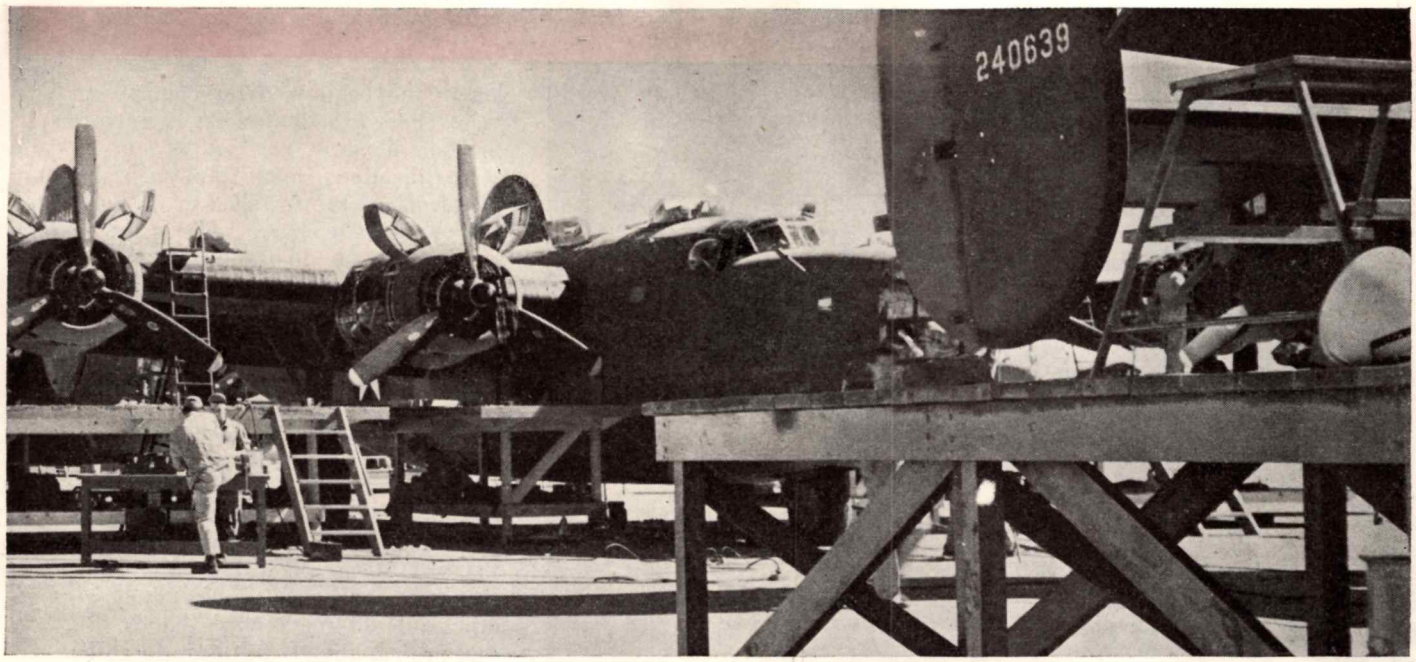
Alterations indicated as a result of hard-won experience gained at the front constitute a large proportion of the work. For example, production warplanes are fitted by United Air Lines mechanics for operation in the jungles or the Arctic, in the desert or at seaside—as the need may be. New situations in the war theaters may call for increasing the range of a bomber, or perhaps for modification permitting a heavier bomb load at the expense of other factors.

The strict secrecy which has cloaked every aspect of the activities at these centers is readily understood when it is considered that many of these last-minute changes to combat-bound craft embody important little strategems which often depend wholly on the element of surprise. As one of the officials has put it: "When we make modifications, we want to catch the enemy totally unprepared."

Nevertheless, some slight appreciation of the precision methods being used at Cheyenne may be gained from a random item that has been released, relating to a specific device employed at the center. Thus, parts necessary for a particular modification on a *Flying Fortress* are placed in a bin at-



Right: Women are doing their bit at Cheyenne, as elsewhere, in outfitting planes for combat duty



tached to the under side of the wing. They accompany the plane from the time it goes on the production line at one end, until it comes off at the other.

Personnel at this modification center is made up largely of civilian recruits. The percentage of women is about the same as that for those employed in aircraft factories.

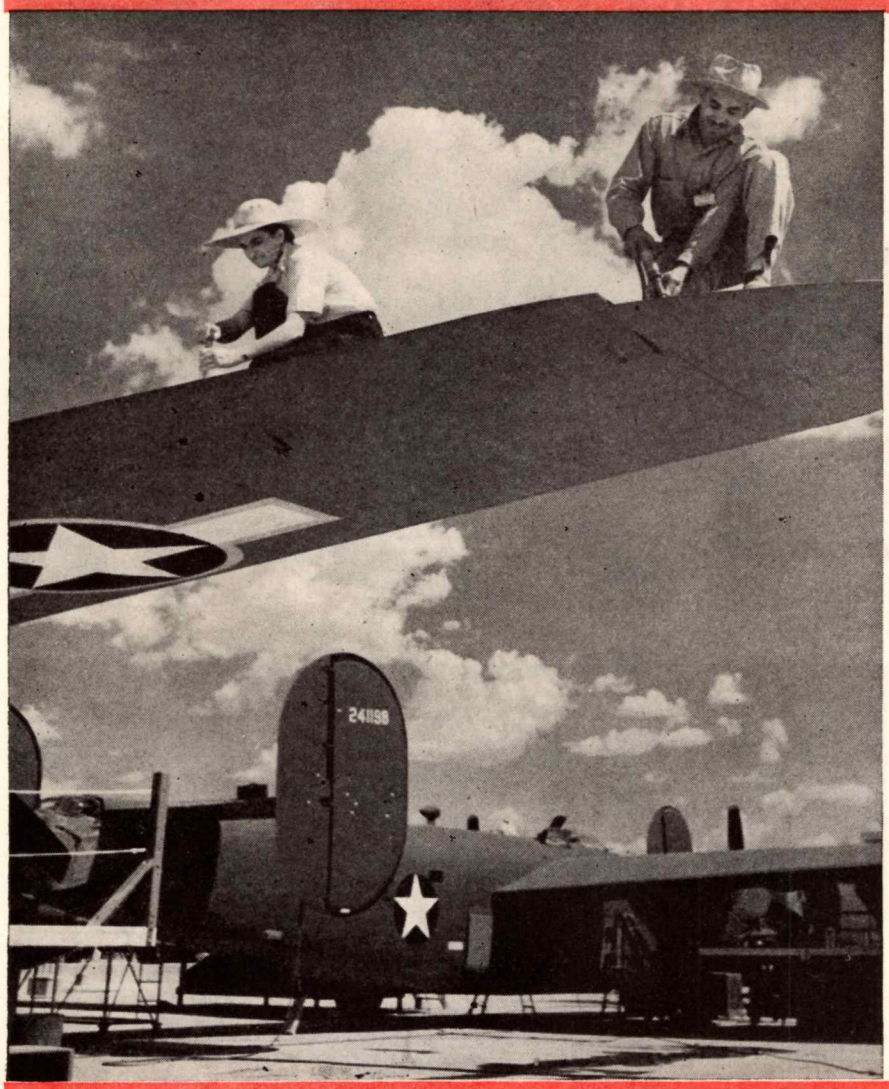
The "Liberator" Base at Tucson

The base maintained by Consolidated near Tucson, where *Liberators* are fitted for combat, offers several additional features of significance in a comparative view of the work being accomplished at the various modification centers throughout the land.

The entire *Liberator* output at the company's San Diego plant, as a matter of course, is flown across the Arizona desert to Tucson, where the last-minute requirements of the battle-fronts are interpreted in terms of alterations and new parts produced on the spot by the center's tooling and fabricating departments.

So considerable is the volume of these final changes, and so many of them are eventually incorporated in the assembly line arrangements at the parent plant, that Consolidated has long ago come to consider the modification center as an integral part of the production sequence. Thus some 75% of the center's work, classed as "temporary," involves changes to be made there only until the main factory has

Outside work such as this, at the Tucson center, is usually carried out during cooler hours of evening



had time to adopt them. The other 25% constitute such "permanent" or extra-standard alterations as weatherization.

On *Liberator* changes that are to be adopted at San Diego, the engineers at Tucson forward to the parent plant copies of the drawings and specifications made up for use at the center. Until these changes have been transferred to the main production lines, Tucson continues to handle such fabrication and installation work.

Outdoor Work

Four modification lines are in use at the Arizona base. Two of these are completely outdoors, while on the others the aircraft are started in the open, are pulled in groups by tractors through successive stations within a hangar and then beyond, to emerge at length fully equipped for combat service. There are 12 stations on each of the four lines.

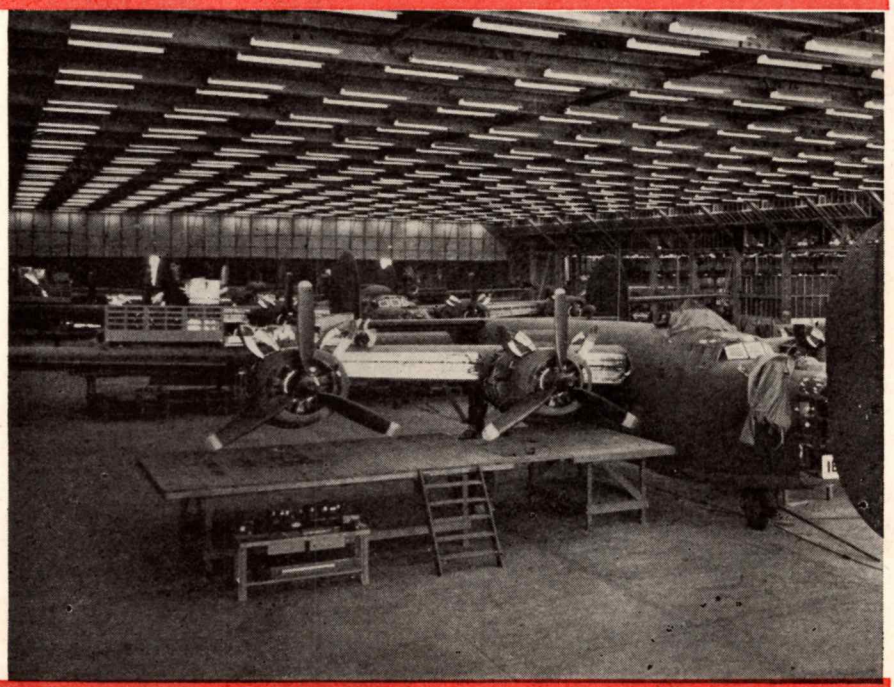
Modifications range from such simple items as the installation of bomb fusing racks to chores such as the rerouting of the hydraulic lines in a bomb bay, so as not to interfere with outsize bombs, and the camouflaging of planes for service in specific localities.

Turret Installation

One of the center's biggest jobs recently has been the installation of the new Sperry ball turret, with the retractable feature so necessary for the low-slung *Liberators*. Only lately has the San Diego plant begun to equip them with this new turret, taking another job off the center's hands. But that project already has been forgotten in the haste of tooling up for the installation of revolutionary new anti-icing equipment.

The modification center is looked upon today as an extension of the aircraft manufacturing plant. When a plane leaves the center at Tucson, at Cheyenne, or anywhere else, it must be ready to carry out its military mission.

Left: "Liberator" wing receives finishing touches under Arizona skies. Wing area 1048 sq ft, span 110 ft



Below: "Liberator" bombers await final changes in hangar of Consolidated's modification center at Tucson

A NEW AVIATION GREASE... LOW-TEMP THAT WORKS AT...

MINUS 100° F.

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40,000 Ft.

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BASED on the belief that the stratosphere temperature was minus 67°F., Aviation greases were developed to lubricate critical airplane controls at or above this temperature.

However, recent test flights in the stratosphere recorded temperatures ranging between minus 80°F. and minus 90°F. and other tests registered still lower temperatures. The U. S. Weather Bureau has confirmed that temperatures lower than minus 67°F. exist in the upper air at all U. S. stations on practically all days.

On these test flights, greases made for minus 67°F. temperature froze up when the stratosphere was reached. To correct this serious condition, Texaco developed a product which will permit all parts of the plane where it is used to function perfectly... *even at minus 100°F. This product is Texaco* **LOW-TEMP** *Grease.*

A Texaco Aviation Engineer will gladly cooperate in the solution of your low temperature problems. Phone the nearest of more than 2300 Texaco distributing points, or write The Texas Company, *Aviation Division,* 135 East 42nd Street, New York 17, New York.

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TEXACO LOW-TEMP GREASE

TUNE IN THE TEXACO STAR THEATRE EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS

SEPTEMBER 1943

WASHINGTON In-formation

RICHARD E. SAUNDERS
Washington Correspondent

THANKS to refresher courses at the grass roots school of public opinion, members of Congress are trickling back to the Capitol with a little clearer concept of the course they should pursue during the balance of the session. The interlude with the home folks has served to dispel all legislative doubts as to the trend of thinking throughout the country in one particular respect. It is that the American public wants no more fooling. Apparently, the people on the farms, along Main Street, and in sprawling industrial cities realize much better than Washington does that we have a grim war on our hands. They are willing to make any effort or to submit to any sacrifice provided they are given the reasons. But they are just about fed up with domestic policies that substitute cajollery and manufactured scares for factual explanations as to why various courses of action are necessary.

A case in point is the recent wave of hysteria over what was described in official statements as an "alarming" decline in airplane production. Various bureaus scolded the industry and the public generally as to the causes for this deplorable situation. They also quarreled with each other about it. The truth of the matter was that there had been no dropping off in airplane production. It was simply that the monthly output while soaring to unprecedented heights had failed to reach the accelerated goals called for in the schedules. July production reached the record peak of 7373 planes.

Acme Photo

Thirty-four "Fortresses" of the U. S. Eighth Air Force start out on a bombing mission over Germany

Sentiment for National Conscription

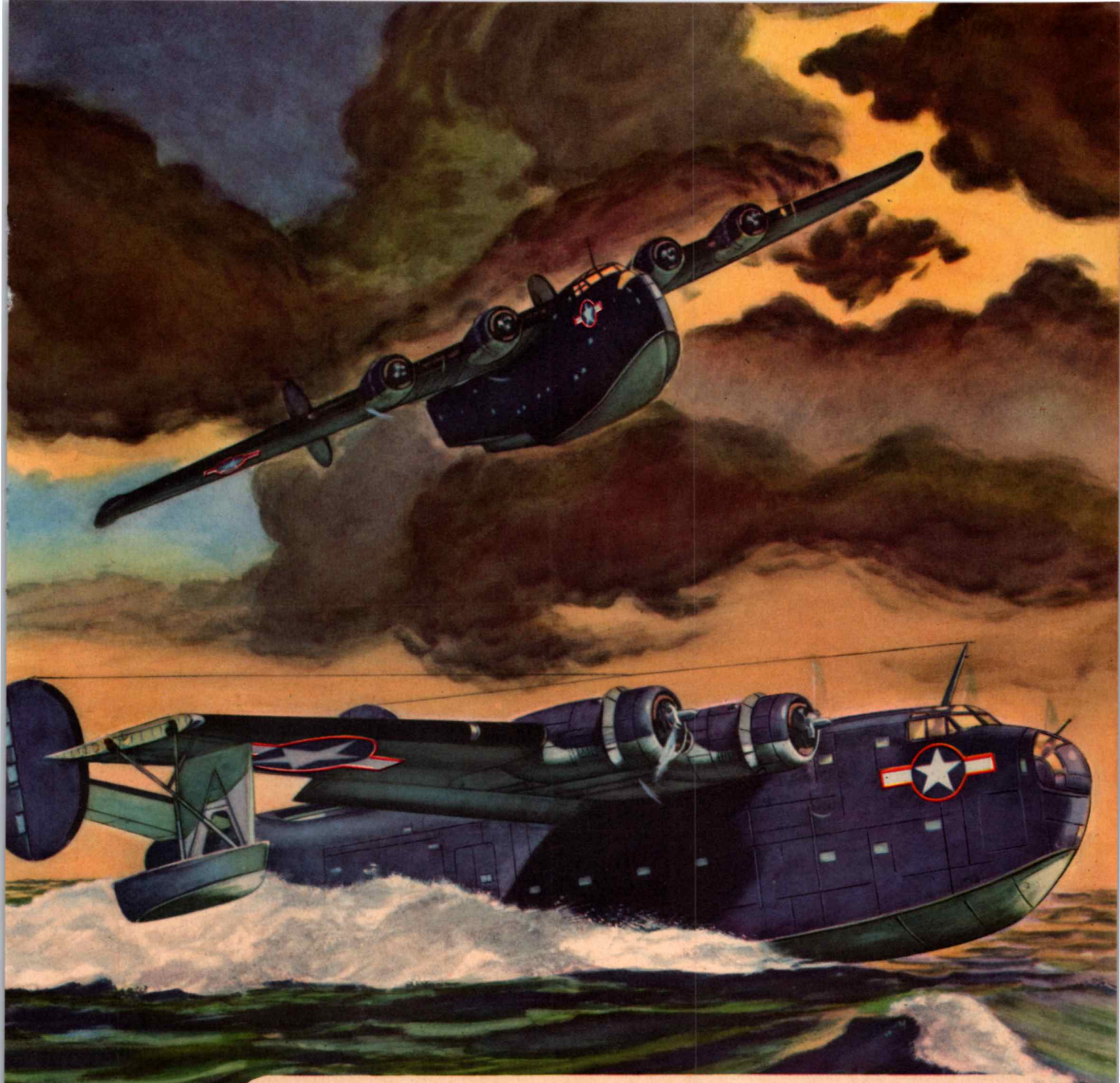
It is true that the airplane production problem is as difficult and complicated as they come. Perhaps its details are more than can be coped with by the legislative process. But returning Congressmen are beginning to realize that general remedial measures are within their grasp. First they can see to it that over-all policies dealing with such matters as the draft, manpower mobilization and the distribution of critical materials between essential war industries are expressed with greater clarity. Incidentally, sentiment seems to be veering more and more toward national conscription as the only feasible way of utilizing manpower resources most effectively.

An admittedly tougher job for Congress is to knock a few administrative heads together to insure that policies are adhered to once they are stated. This calls for constant surveillance rather than the passage of any particular measure. For example, the law ousting professors and crackpots from key positions in the war agencies seems to have been only partly observed. In quite a few cases, at least, the offending parties while replaced by more experienced men were immediately shifted to other jobs. These jobs are just as important in their mischief-making potentialities even though they carry less impressive titles. Thus it is obvious that Congress is not finished with its house cleaning.

Another "Dream Book"

What seems to have touched off the airplane production squabble was a tight manpower situation on the west coast. About the middle of July the War Department complained to the War Manpower Commission about the difficulties the aircraft manufacturers in this section were having in getting enough workers. Characteristically, the WMC began preparing what is called in Washington parlance a "dream book" on the subject. It has an entrancing study on its hands and wanted to make the most of it. Finally, the Army got tired of waiting and dumped the problem into the lap of War Mobilization Director Byrnes. There were conferences and huddles

(*Continued on page* 138)



The B.F. Goodrich Airplane of the month

CONSOLIDATED PB2Y-3

FIRST TO SPOT AND CONTACT the enemy in many a sea battle are these great patrol bombers of the U. S. Navy which operate thousands of miles out ahead of the fleet. Popularly called the Coronado, the PB2Y-3, built by Consolidated Vultee Aircraft Corporation, is the largest and most powerful mass production airplane in Navy service.

B. F. Goodrich equipment helps the Coronado perform its vital tasks with greater safety and efficiency. De-Icers, for example, crack off dangerous ice when it forms on wing and tail surfaces. And in the thick of battle, B. F. Goodrich Bullet-Sealing Fuel-Cells cut the hazard of gasoline leakage and explosion.

To the men who fly them, a nation's praise and gratitude. To the plane itself, a salute, and our nomination as "Plane of the Month."

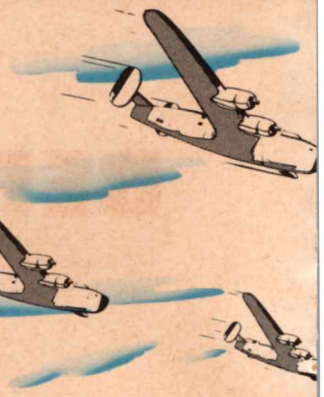
In war or peace

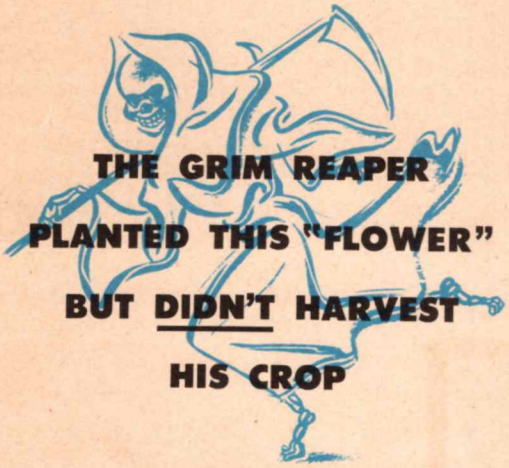
B.F.Goodrich

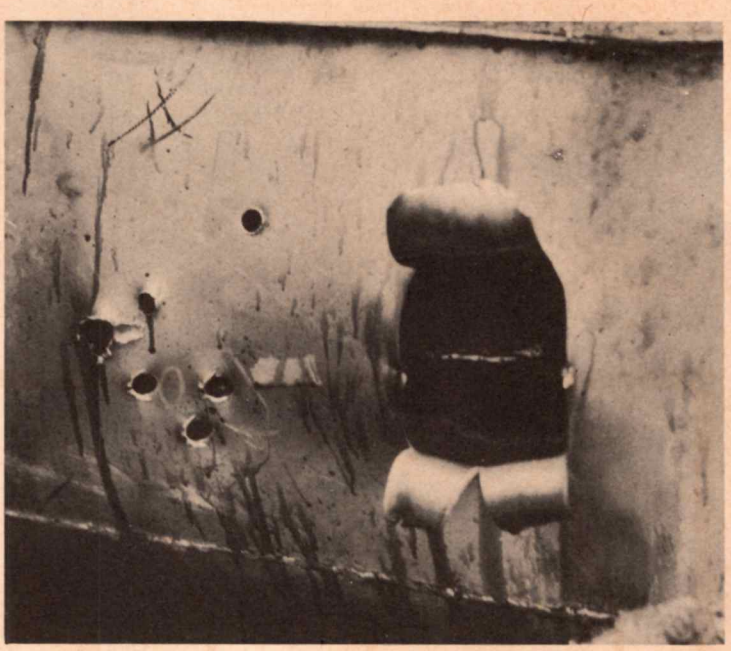
FIRST IN RUBBER

DICK LOUIS

B.F. GOODRICH RUBBER RESEARCH FOR THE *Aviation industry*







A MACHINE GUN SLUG made the gaping hole shown at right . . . a slug ripping out through a fighter plane's fuel tank. And this jagged hole—called a "flower" by technical men—would have written a flaming finis to a fighter pilot's life if it had been made just a few years ago. For then, gasoline would have poured through . . . ignited . . . !

Today it's different . . . with *our* planes at least. Our fliers cheat death time and again because *their* fuel reservoirs can take it. They can be pierced by 30's, 50's, even 20-mm. cannon shells . . . "flowers" can bloom all over their outside surfaces . . . but the bullet-sealing *inside* lining holds.

On this "inside lining" hangs a tale . . . a story of research and development that B. F. Goodrich had a large part in writing. It starts back in World War I when engineers first attempted to make fuel tanks self-sealing. Some initial success was achieved by covering the *outside* of a regular tank with rubber compounds and then covering the rubber with a protective layer of leather. But as the power of gunfire increased, the outside covering method lost its effectiveness. Bullets passing through would force out jagged "flowers" on the exit side and rip off large sections of the covering—making self-sealing impossible.

B. F. Goodrich engineers were first to work out a practical solution to this "flowering" problem. They lined a tank instead of covering it, and in so doing made the forerunner of the bullet-sealing fuel cell most commonly used today. The schematic drawings on the opposite page show why the inside lining works where the outside covering failed.

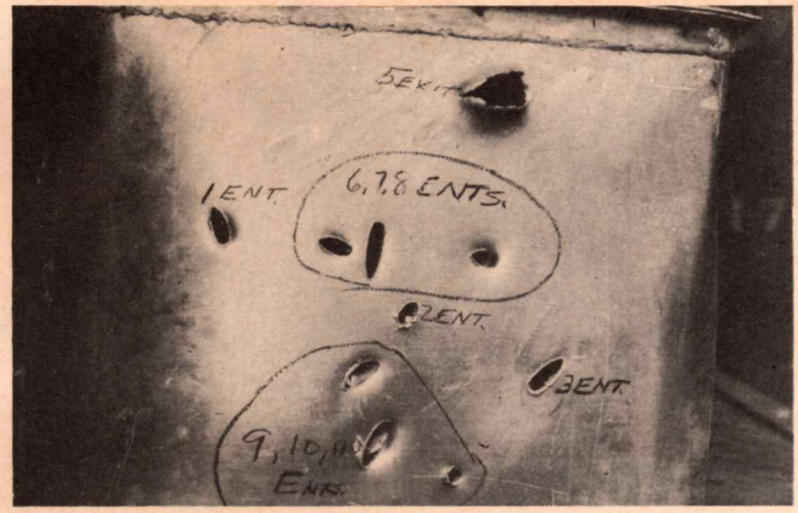
The development of the leak-proof tank insert is just one of many contributions B. F. Goodrich has made. Our engineers have done extensive work in compounding improved sealant materials. They have supplied linings and sealants that function satisfactorily in contact with aromatic fuels which tend to dissolve ordinary materials. They have devised special forms on which to build fuel tanks, which can be made up in all of the great variety of complex shapes required. They developed synthetic rubber molded connections and effective adhesives for use in fuel-cell constructions. They constructed self-sealing hose to assure safe transmission of the fuel from the fuel tank to the airplane's engines.

MAKERS OF B. F. GOODRICH TIRES AND OVER 80 RUBBER AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES

Awarded to seven plants

Firing tests prove fuel cells can take it

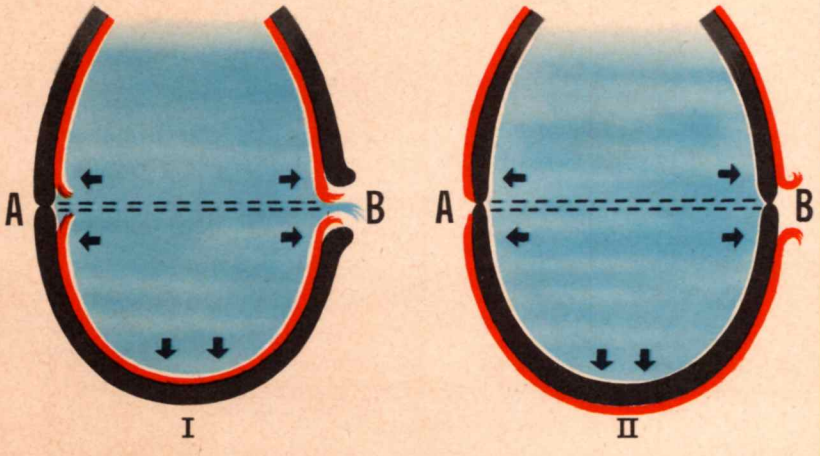
BEFORE THEY TAKE OFF !



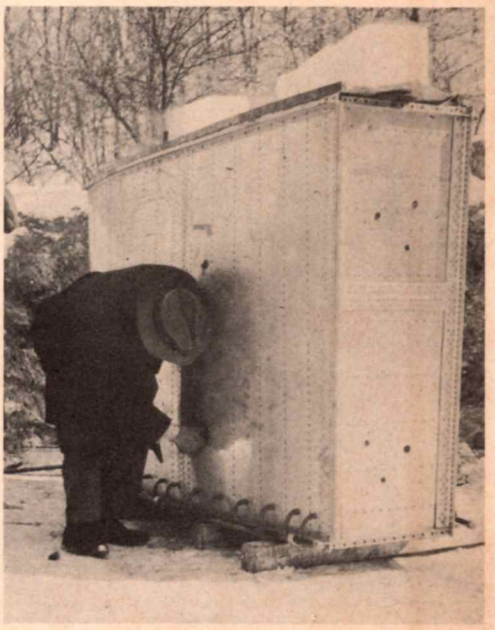
Every combat condition is simulated in these tests...

Machine gun bullets—both 30's and 50's—incendiaries, and cannon shells are fired at test tanks filled with gasoline. Shot after shot is pumped into them from all angles to see how much they can take without leaking or exploding. Bullets are even ricochetted into the tanks to simulate deflection from a strut, propeller or some other part of the plane under fire. And these tests prove that tanks with B. F. Goodrich bullet-sealing inserts can absorb the terrific punishment necessary to bring our planes back after sky battles against overwhelming odds.

How "flowering" was licked with B. F. Goodrich bullet-sealing inserts



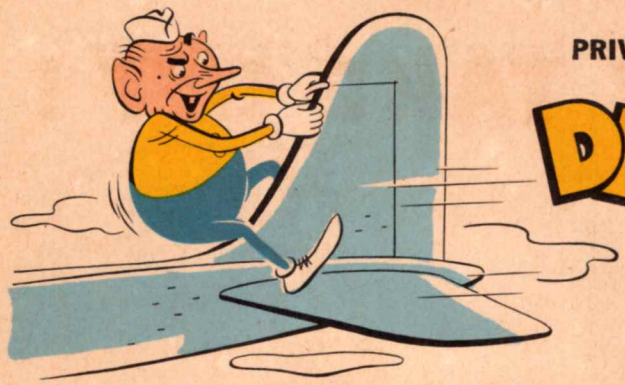
The two schematic cross-section drawings above show what happens when high-power bullets pierce the old-type covered tank and the modern "lined" tank. Bullet enters at (A) and exits at (B) in both; arrows indicate pressure direction. In sketch I (old type) fuel rushing out of (A) under pressure forces covering from side of tank, thus retarding self-sealing there. At (B) the terrific force causes the metal to flower, ripping a big jagged hole in the covering and stripping it off the outside. Obviously, sealing is impossible. In sketch II (modern type) the pressure exerted at (A) holds the insert tight against the metal tank and prevents separation. At (B) pressure again holds the insert tight against the tank; thus the bullet makes a cleaner hole in insert, and the flowering, being outside, is harmless.



In war or peace

B.F.Goodrich

FIRST IN RUBBER



PRIVATE GEORGIE GREMLIN SCORED 0 ON THIS

DE-ICER QUIZ

CAN YOU SCORE 100%?

Complete the ten statements by simply picking the one correct part (a, b or c) following each numbered statement. See if you can get them all.

1. De-Icers are located on . . .

a. The leading edges of wing and tail surfaces.
b. Carburetor air intakes.
c. Windshields.

2. De-Icers are made of . . .

a. Chrome-tanned elkhide.
b. Rubber and fabric.
c. Specially rolled 88-gauge aluminum alloy.

3. Each De-Icer contains . . .

a. Central tube area flanked on top and bottom by elastic stretch areas.
b. An electric heating unit encased in rubber.
c. Perforated layers of metal-reinforced leather.

4. De-Icers are operated by . . .

a. Super-heated oil at 10 lb. per sq. in. internal pressure.
b. Air.
c. Alcohol and carbon tetrachloride.

5. A De-Icer's tubes pulsate in order to . . .

a. Keep rubber from freezing.
b. Keep ice from forming.
c. Crack off ice after it forms.

6. Aluminum fairing strips are used in De-Icer installations . . .

a. To drain static electricity from De-Icer surface.
b. Because brass is not obtainable.
c. To streamline the De-Icer attachment and to act as a washer strip for the attachment screws.

7. De-Icers are attached with . . .

a. Rivnuts and screws.
b. Rivets.
c. Zoot nuts.

8. Metal end strips are used to . . .

a. Cut down wing flutter.
b. Prevent endwise creep or movement of the De-Icer.
c. To restrict tube inflation.

9. The outer surface of De-Icers is covered with a special conductive coating which . . .

a. Sets up anti-magnetic waves.
b. Bleeds off static charges that might cause punctures and explosions.
c. Cuts down air friction.

10. The rows of small vent holes in the top and bottom elastic areas are placed there to . . .

a. Trap wing-boring gremlins.
b. Cool the De-Icer system when it is not in use.
c. Facilitate movement during inflation and aid in keeping the deflated De-Icer tight against the wing.

WHAT IS YOUR SCORE?

Each correct answer counts 10. 1-a, 2-b, 3-a, 4-b, 5-c, 6-c, 7-a, 8-b, 9-b, 10-c.

This is one of a series of maintenance quizzes prepared for ground crew trainees of the U. S. Army Air Forces Technical Training Command. It is our hope that this series will help all maintenance men get maximum service, safety, and efficiency from military, commercial, and civilian aviation equipment.

B. F. GOODRICH, AERONAUTICAL DIVISION, AKRON, O.

Skyway or Highway

B.F.Goodrich

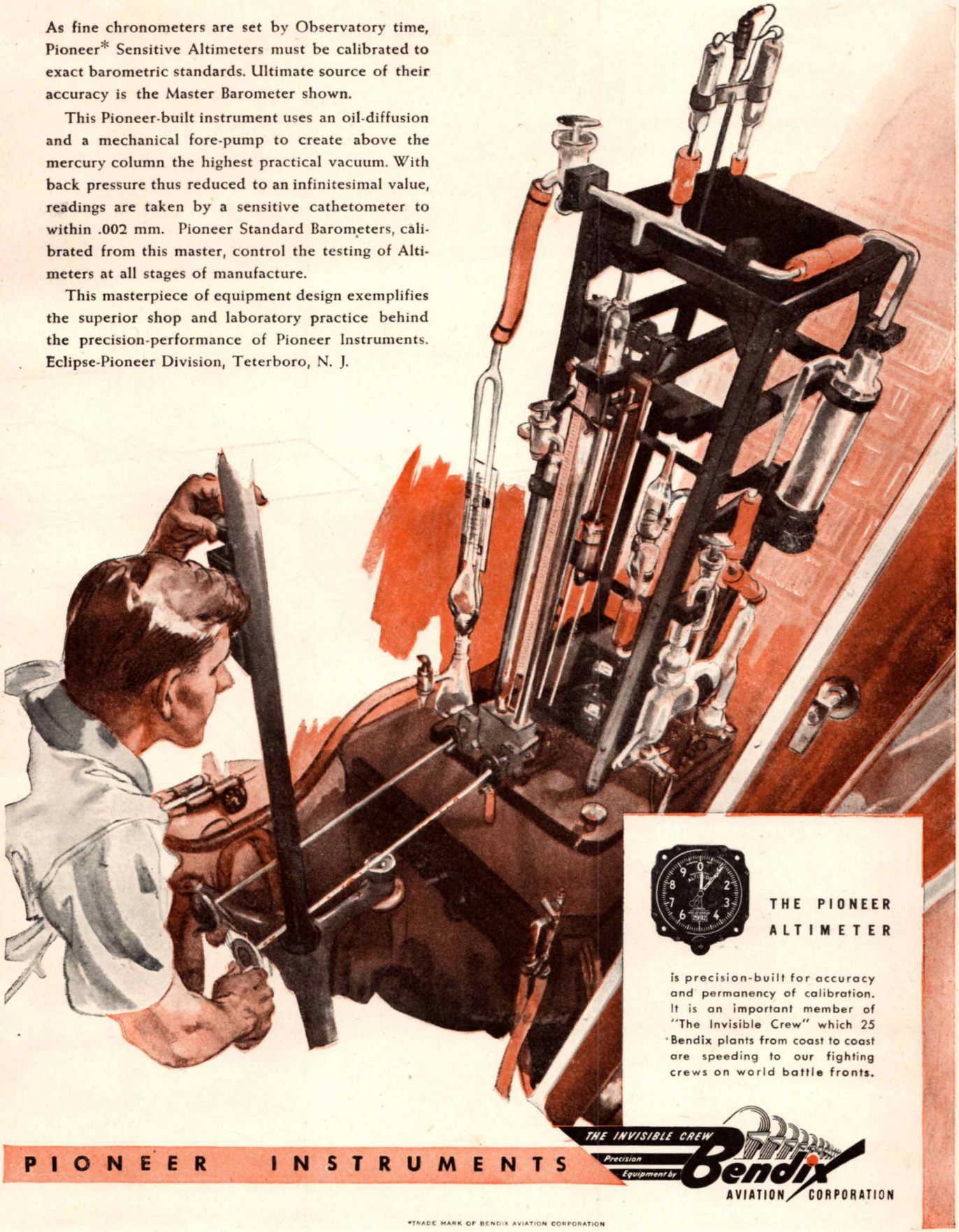
FIRST IN RUBBER

Ultimate Source of Altimeter Accuracy

As fine chronometers are set by Observatory time, Pioneer* Sensitive Altimeters must be calibrated to exact barometric standards. Ultimate source of their accuracy is the Master Barometer shown.

This Pioneer-built instrument uses an oil-diffusion and a mechanical fore-pump to create above the mercury column the highest practical vacuum. With back pressure thus reduced to an infinitesimal value, readings are taken by a sensitive cathetometer to within .002 mm. Pioneer Standard Barometers, calibrated from this master, control the testing of Altimeters at all stages of manufacture.

This masterpiece of equipment design exemplifies the superior shop and laboratory practice behind the precision-performance of Pioneer Instruments. Eclipse-Pioneer Division, Teterboro, N. J.



THE PIONEER ALTIMETER

is precision-built for accuracy and permanency of calibration. It is an important member of "The Invisible Crew" which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

PIONEER INSTRUMENTS

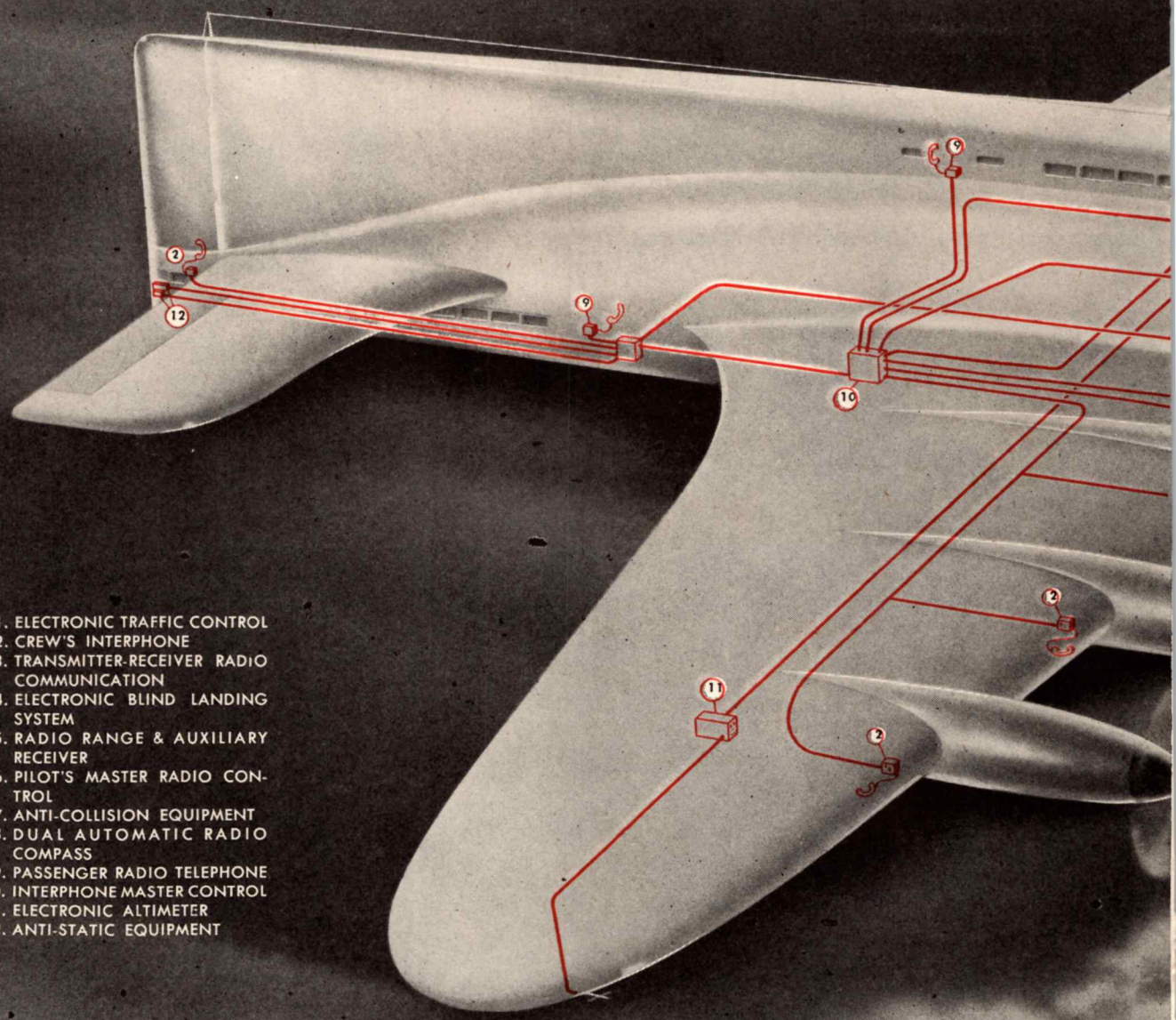
THE INVISIBLE CREW

Precision Equipment by Bendix AVIATION CORPORATION

*TRADE MARK OF BENDIX AVIATION CORPORATION

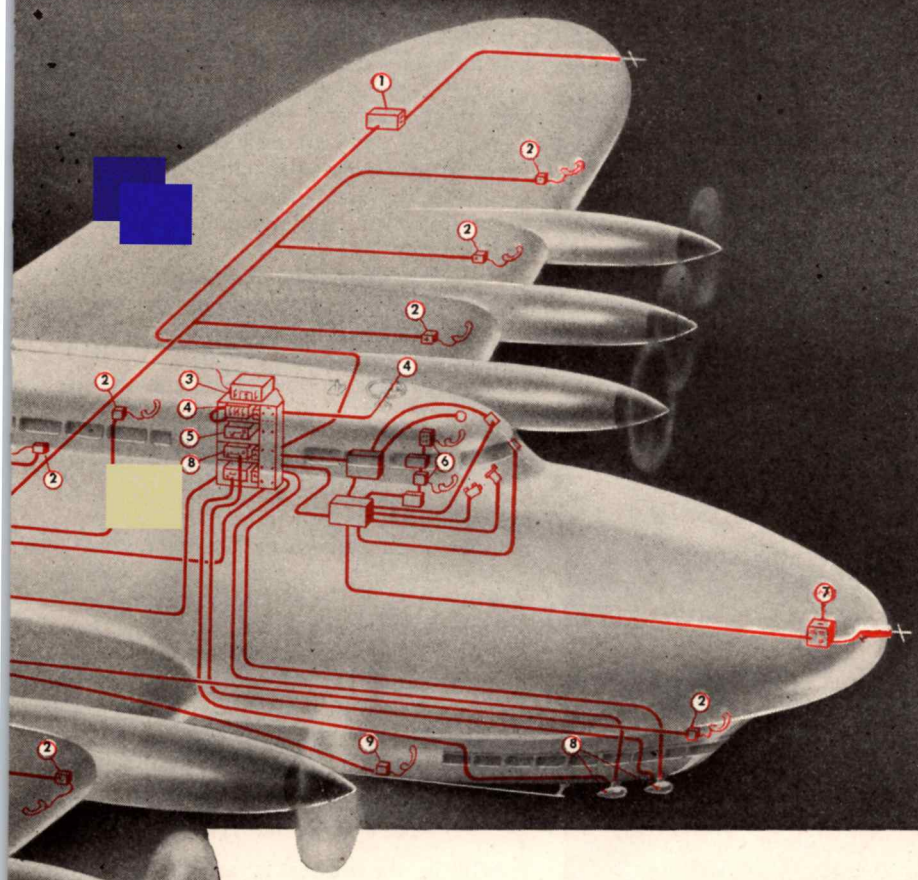
Electronic Systems for

Long before the war, American Export Airlines giant "Flying Aces" were equipped complete with radio transmitting, receiving and direction-finding equipment...designed and built by Bendix Radio.



1. ELECTRONIC TRAFFIC CONTROL
2. CREW'S INTERPHONE
3. TRANSMITTER-RECEIVER RADIO COMMUNICATION
4. ELECTRONIC BLIND LANDING SYSTEM
5. RADIO RANGE & AUXILIARY RECEIVER
6. PILOT'S MASTER RADIO CONTROL
7. ANTI-COLLISION EQUIPMENT
8. DUAL AUTOMATIC RADIO COMPASS
9. PASSENGER RADIO TELEPHONE
10. INTERPHONE MASTER CONTROL
11. ELECTRONIC ALTIMETER
12. ANTI-STATIC EQUIPMENT

the Skyliners of the FUTURE



Engineering the complete RADIO ELECTRONIC SYSTEM is the business of BENDIX RADIO!

Vastly more than transmitters and receivers make up the radio-electronic system of a long-range bomber or transport. Even for pre-war airliners, Bendix Radio and airline engineers cooperated to design complete radio systems . . . custom-built.

Radio transmitters and receivers, interphone systems, remote indicating radio navigating installations . . . these and other complex electronic equipment comprise the signal corps of "The Invisible Crew." Designing and producing this whole network, with all necessary wiring, conduits and connections, is the business of Bendix Radio . . . now going forward on a vastly increased scale.

Back of these vital members of "The Invisible Crew" stand the specialized experience and pre-war "know-how" of Bendix Radio engineers . . . helping to make our fighting machines *The Vehicles of Victory*, and *The Transports of Tomorrow*.

Products of this division are vital members of "The Invisible Crew"—precision equipment which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

BENDIX RADIO **BENDIX RADIO DIVISION**

WASHINGTON IN-FORMATION

(*Continued from page* 130)

galore. The ball was tossed back and forth between the WMC, the WPB, and the WLB not to mention a few other agencies.

As a result of all the different appraisals, a few facts as to the cause of the trouble began to emerge. It was disclosed for one thing that the problem of retaining workers in the west coast plants is more serious than that of recruiting them. Further checking showed that most workers are quitting because of unsatisfactory housing and living conditions—a revelation that reflects seriously on the competence of the agencies responsible for the housing and community facilities programs. Other factors found to be responsible for the excessive labor turnover are the relatively higher wage scale in nearby shipyards and the muddled situation concerning draft deferment.

Remedial action has been less swift than the diagnosis of the malady. One proposal advanced is that upward adjustments be made in the wage scales of west coast aircraft plants so as to place them on a parity with the shipyards. Because of the wage-freezing order the matter is entirely beyond the control of the manufacturers. The War Labor Board must give its assent, and this agency seems inclined to demur. As is eternally the case with bureaucracies, it dreads setting a precedent. Other corrective steps proposed are that aircraft workers be granted draft deferment for the duration and that arrangements be made for subcontracting more of the work outside of the labor short areas.

Too Many Modification Orders?

It is of course apparent to the more discerning federal officials that the aircraft industry has other matters to worry about besides manpower. The Truman Investigating Committee of the Senate recently put its finger on one of the chief causes of production headaches. After a brief field trip members of its Aviation Subcommittee stated that a major deterrent to the maintenance of production schedules is the Army's continual insistence on modifications in plans. No one supposes that the Army orders these changes capriciously. The military men naturally want to incorporate into current production the lessons being learned in battle areas. Nevertheless it is felt that the industry should not be blamed for this retarding influence. Some members of the Truman Committee go even further than this and take the view that the Army should be a little less hasty in issuing modification orders.

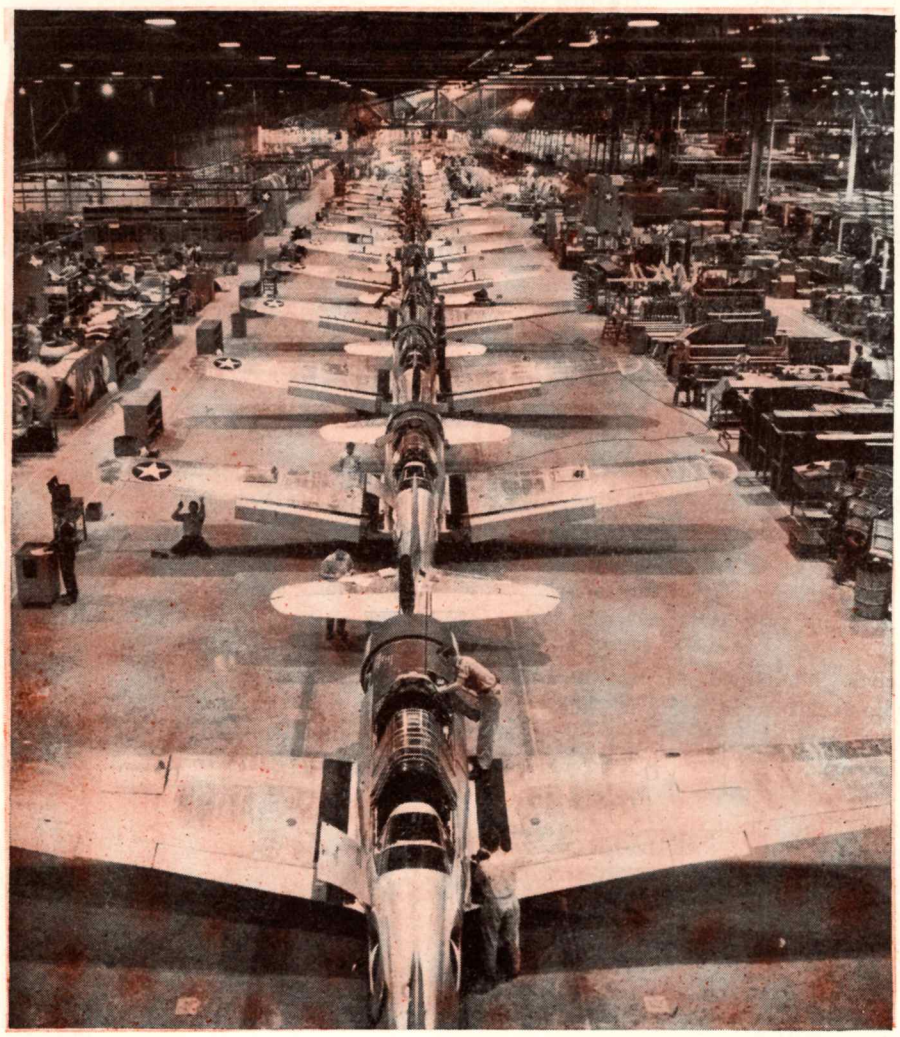
Agreeing that changes in specification are mainly responsible for the failure of aircraft production to reach its July quota of 8000 planes, WPB Chairman Nelson has become somewhat annoyed over charges that a lag in the output of engines was a major factor. A survey made at his request shows that next to modifications, the most serious retarding factors are manpower shortages and turnover, the excessively hot weather which the country has suffered, and delays in shipping materials and component parts. If the production of engines failed to reach the desired goal it was due to these other causes. In other words, the plants turning out engines suffered the same production ailments as the airframe makers.

Acknowledging Air Power

Still in the offing is an executive order of some kind which would give the Army Air Forces a virtually independent status. As was mentioned in this column last month, the increasingly effective role that airpower is playing in the war has convinced high official minds that such a move is desirable. But the final outcome remains uncertain. The draft of a directive has been submitted to the President, it is understood. Apparently, the Navy is not involved. From what can be learned, the scheme is to free the AAF of the last vestige of control exercised by the land branches and to create a Chief of Staff for Air. Whether this would satisfy Congressional advocates of a unified air service remains to be seen.

Meanwhile, a development of no little significance is the emergence of Admiral H. E. Yarnell as a believer in the cause of consolidation. Retired former commander-in-chief of the U. S. Asiatic fleet Admiral Yarnell was recently called back to active duty in the office of Admiral Ernest J. King. What he proposes is the merging of

(*Continued on page* 263)



"Valiants", Consolidated Vultee's basic trainers, on the powered conveyor final assembly line, said to be the world's fastest. The trainers move tail first as they progress to completion

More PRODUCTION AT Less EXPENSE FROM YOUR AIR TOOLS

● Carefully made of the best materials, from correct designs, CLECO pneumatic tools are built to stand the service on *any* job. However, increased production depends upon a few simple precautions, which often have no bearing directly on the tool itself. Here are a few:

Be sure to use the right grade of oil. In general, a light oil of high quality is what you need.

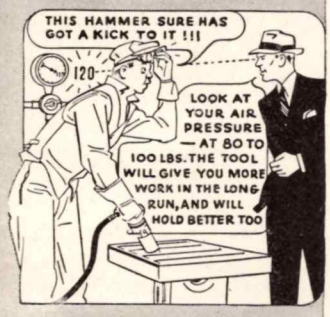
Avoid abusing the tool by rough handling, permitting parts to become loose; using unsuitable wrenches, or clamping the body of the tool in a vise. Leave repairing to the regular tool repair man.

Use adequate hose and pipe lines, with traps for water and trash.

Oil the tool about once an hour when the service is continuous.

Don't remove screens in connection bushings.

Use air of the correct pressure, generally 80 to 100 pounds at the tool.



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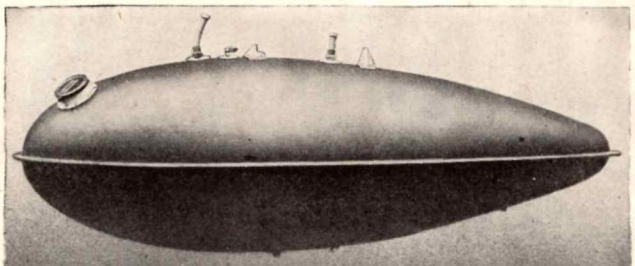

*A JETTISON GAS TANK** made of National Vulcanized Fibre by U. S. Rubber Co. These auxiliary gas tanks are hooked beneath the wings or fuselage of a plane. When empty, they may be dropped to reduce "air friction." Produced in sizes, 50 to 250 gallons capacity.

Thanks to the development of jettison gas tanks made of lightweight, strong National Vulcanized Fibre, our army planes get increased gas loads, providing wider flying range . . . our aviators are able to carry the fight farther away . . . are able to ferry planes longer distances. This use of National Vulcanized Fibre is typical of the war work of our company . . . supplying materials for everything that "flies, floats or shoots."

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*Photo by U. S. Army Air Forces

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Metal Specialty's plants are equipped to render you complete service in the fabrication of all Metal Parts, and in Plastic Injection Molding up through 18 ounces per shot. Along with 850-ton self-contained hydraulic presses for Metal Working, Metal Specialty has one of the four 18-36 ounce capacity injection presses for Custom Molding together with full complementary equipment.

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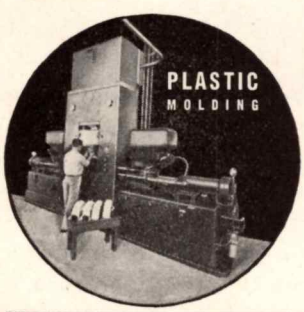
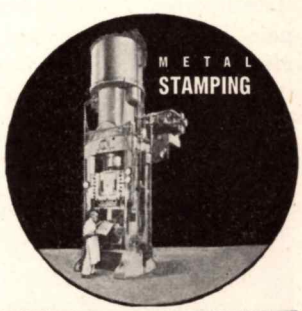
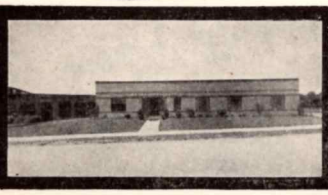




ARMY E NAVY



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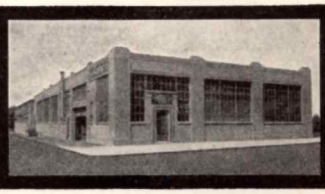
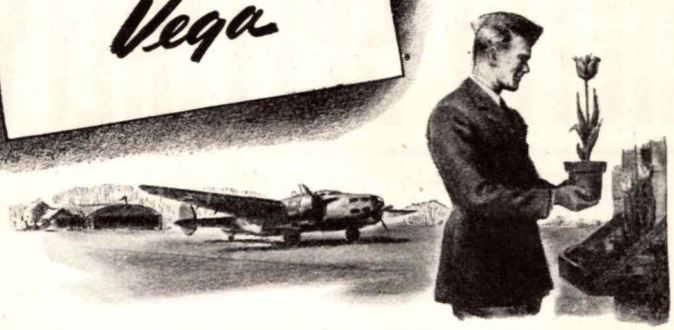


TRUE STORIES ABOUT *Vega*

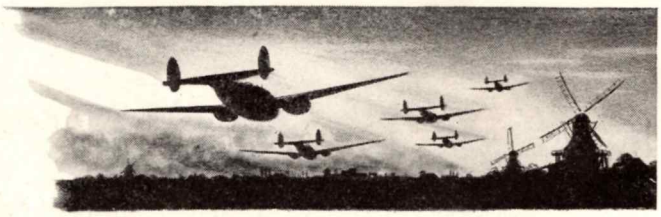
HOLLAND EARTH FOR A HOMESICK DUTCHMAN

How a Vega Ventura Bomber Brought Home Dirt from the Land it Raided!

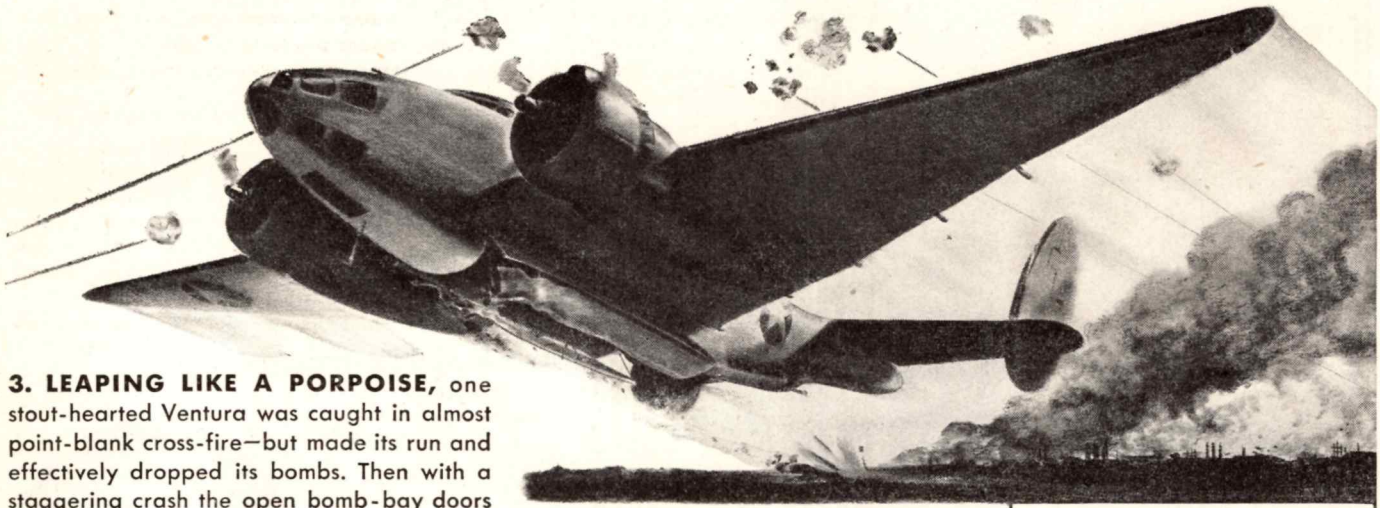
A handful of Holland earth, scraped from the bomb-bay doors of a returned Ventura medium bomber—back victorious from a smashing raid on Axis-held Europe—tells an exciting, true story of the dependability of one fighting American warplane.



1. VEGA VENTURA medium bombers were chosen for a smashing role in the big daylight raid on the Philips Wireless Works in Eindhoven, Holland. Last to go over the target, their job was to drop incendiaries from roof-top heights on factory buildings already damaged by high-explosive bombs dropped by other aircraft earlier in the raid.



2. AT TREE TOP LEVEL they swept in—lower even than the "flak towers" built to protect this vital Nazi supply center. The defensive gunfire was heavy, and many a crewman saw the interior of his Ventura clearly lighted by licking tongues of flame from burning buildings or by exploding shells.



3. LEAPING LIKE A PORPOISE, one stout-hearted Ventura was caught in almost point-blank cross-fire—but made its run and effectively dropped its bombs. Then with a staggering crash the open bomb-bay doors scraped the ground!

4. A BREATHTAKING MOMENT—Then with a surge of its two powerful engines, the Ventura fought its way up into the air again, away from danger, and across the channel to its home base in England.

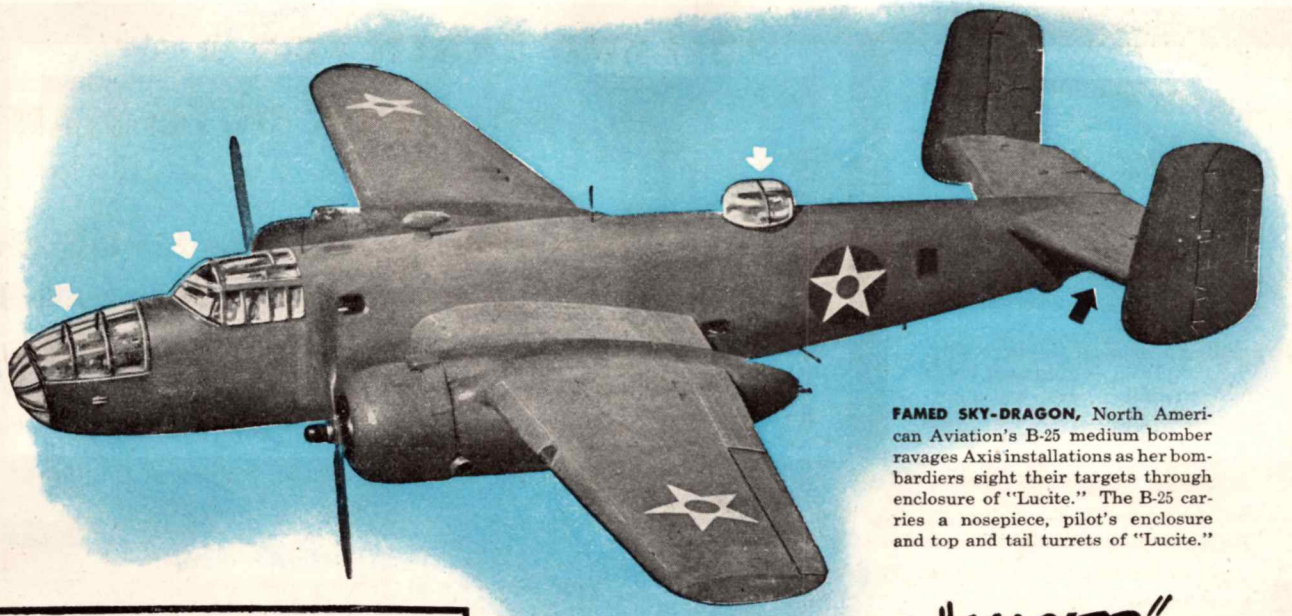
5. CAKED IN THE CHINKS of its battered bomb-bay doors was a present for a homesick Hollander. It was Dutch soil—scooped from the Netherlands and brought back by the Vega Ventura—an American bomber tough enough to take a direct hit, bounce off the ground, and still fly its crew home safely.

This is another in a series of stories about Lockheed and Vega and their accomplishments. Watch the pages of this magazine for another true aviation adventure.

Vega

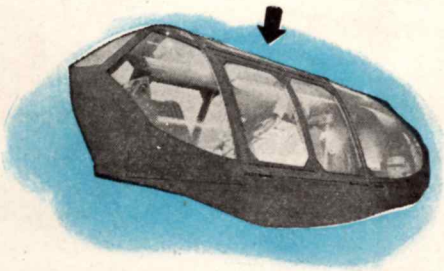
AIRCRAFT CORPORATION

A Subsidiary of Lockheed Aircraft Corp.
Burbank, California

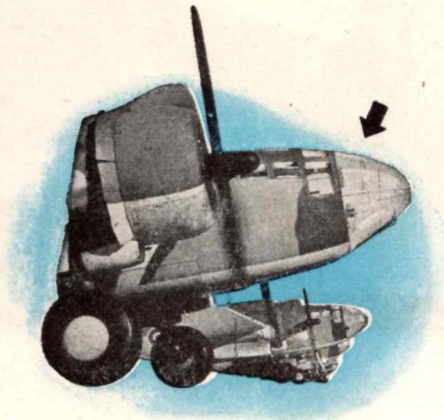


FAMED SKY-DRAGON, North American Aviation's B-25 medium bomber ravages Axis installations as her bombardiers sight their targets through enclosure of "Lucite." The B-25 carries a nosepiece, pilot's enclosure and top and tail turrets of "Lucite."

How Du Pont "LUCITE" serves our WINGS OF WAR



"LUCITE" PERFORMS in the top and side panels of this cockpit canopy. Have you guessed the plane? It's North American's pack of pressed dynamite, the P-51 *Mustang* fighter.



THE NOSE-PIECE of Martin's A-30 *Baltimore* bomber, made entirely of "Lucite," is one of the largest plastic pieces ever produced on mass production scale. Famed for its North African service, especially with the 8th Army, the *Baltimore* carries 21 other transparent parts made from "Lucite."

•

"LUCITE" flies to war also with the Douglas *Havoc*, Lockheed *Lightning*, Republic *Thunderbolt*, Curtiss *Warhawk*, Consolidated *Liberator*, Bell *Airacobra* and many more of our foremost war eagles.

CRYSTAL-CLEAR transparent Du Pont "Lucite" methyl methacrylate resin sheeting serves American battleplanes at any altitude, in every climate, all over the world.

Enclosures, as well as other parts made from "Lucite," are light, strong, resilient—dependable in service. Because the sheeting can be formed into wide areas, "Lucite" allows pilots, navigators, gunners and bombardiers maximum vision under all conditions. If damaged by gunfire, "Lucite" sheeting can be repaired simply and effectively.

Here are some of the properties of cast "Lucite" which explain why *America's outstanding acrylic plastic* lends itself so successfully to the needs of military aircraft. Why, too, "Lucite" will prove so important in the building of our post-war world.

Under standard conditions (77° F. 50% R.H.), cast "Lucite" shows...

Tensile Strength—6,000-9,000 psi
Flexural Strength—10,000-14,000 psi
Impact Strength—(Charpy) 0.4-0.6 ft. lbs. per in. of notch;—(Izod) 0.2-0.4 ft. lbs. per in. of notch
Linear Thermal Expansion—(0°-21°C) 7-9 x 10^{-5} per °C
Yield Temperature—(cantilever beam) 80°C
Light Transmission—(visible range, uncorrected for reflection) 90-92%
Dielectric Constant—(10^6 cycles) 2.5-3.0
Specific Gravity—1.18-1.20
Water Absorption—(24 hours' immersion) 0.2-0.3% by weight
Effect of Sunlight—practically none
Effect of Age—practically none

(Many properties are influenced by temperature, stress applied, alignment of molecules in forming and by contour of finished members, which should be compensated for in design.)

• • •

SEE THIS MANUAL FOR MORE DATA

The 114-page Manual on "Lucite," for aircraft designers, engineers, their established enclosure suppliers and for fabricators of plastics, gives detailed information on fabricating, forming, repairing and general properties of "Lucite." Get your *free* copy. Write on your business letterhead to: E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J., or 5801 So. Broadway, Los Angeles 3, Calif.

DU PONT
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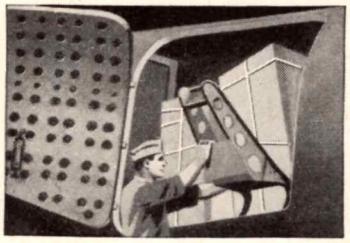
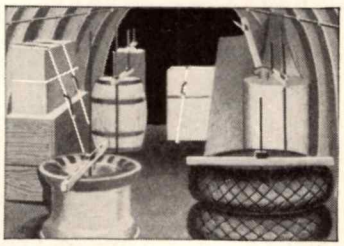
"LUCITE"

methyl methacrylate resin

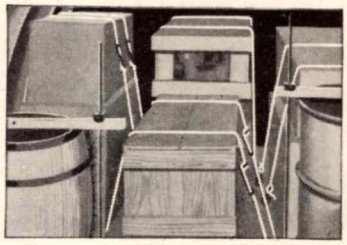
BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*



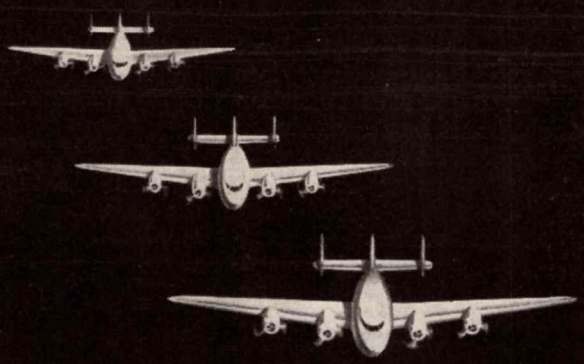
Loading a modern air cargo ship. Evans Skyloader equipment holds any load safely; means more payload, easier loading and unloading.



Hold-down beams securely locked to hook-rods are part of the Evans Skyloader system. Center cases are held firm by rope tighteners.



Even mixed cargoes reach destination snug and secure, held down by Evans Skyloader equipment which eliminates all slack in the load.



trade winds of the future!

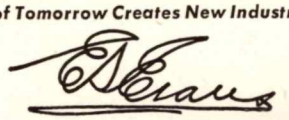
From the days of the old windjammers to the roaring, silver ships of the sky, man has linked his destiny with trade over the seven seas. A new time-saving factor—air cargo—will, when peace comes, hasten restoration of world commerce, open up new markets, blaze new trade routes to distant lands.

Right now, weapons and supplies are rushed, via air cargo, to over 43 global battlefronts. A new industry is being born. Trade always follows the flag!

And in this pioneering of air cargo, Evans Skyloader Hold-down Equipment has simplified the difficult task of making fast all types of shipments. It provides safety to cargo, plane and personnel . . . saves countless, valuable manhours . . . is a vital, lusty force in the Trade Winds of The Future!

★ ★ ★

Vision to Anticipate the Needs of Tomorrow Creates New Industries Today



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"Whats this, Tojo?"

If we could take Premier General Hideki Tojo through the spacious, industrious Herron-Zimmers plant in Detroit, his beady little Jap eyes would fairly bulge through his thick-lensed glasses. For big things are doing at Herron-Zimmers—things that spell a bad day ahead for the Axis. From the peace-time production of metal mouldings, Herron-Zimmers turned itself almost overnight to the design and fabrication of the highly accurate jigs and fixtures demanded in the assembly-line production of improved aircraft and other armament.

To help you solve your war production problems, the counsel of Herron-Zimmers technicians, skilled in the engineering and building of accurate jigs and fixtures, is at your service without obligation.

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Herron-Zimmers will return to the production of metal mouldings for the automotive and building trades . . . with advanced designs and improved qualities resulting from the present efforts of our design engineers and metal technicians in their unceasing search for better performance:

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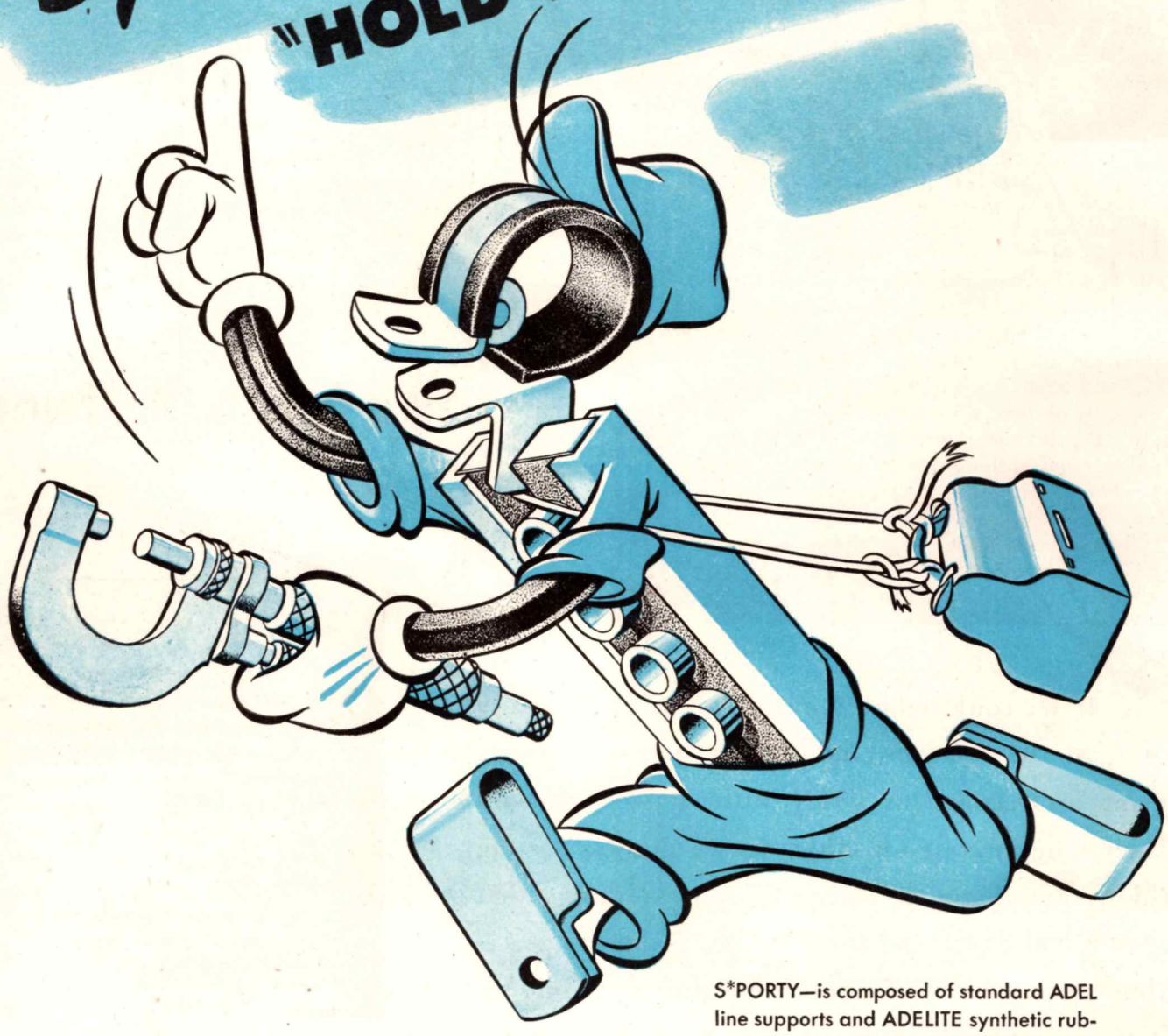
S*porty says "HOLD EVERYTHING!"



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WHEN *salesmen ask you to buy clips and blocks which are supposed to be "just-as-good" as ADEL'S, ask 'em for proof. Remember, these precision-built line supports have been combat tested in United Nations aircraft on every fighting front. Nearly 10,000 production types and sizes available. Millions in use since 1937 by every major American and Canadian aircraft company. For free catalogs and complete information on the correct supports for electric conduits, fuel, oil instrument and hydraulic lines, contact nearest engineering service office.*

S*PORTY—is composed of standard ADEL line supports and ADELITE synthetic rubber material—all except the droopy drawers! ADEL line supports are manufactured under United States Letters Patent No. 2,215,283, 2,227,528, 2,279,865. Other United States and Foreign Patents Pending. No patents on the d-d but Walt Disney has 'em copyrighted!

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Engineering Service Offices: 1411 Fourth Ave., SEATTLE 1, WASHINGTON; Administration Building, Love Field, DALLAS 9, TEXAS; 609 Stephenson Building, DETROIT 2, MICHIGAN; 303 Wareham Building, HAGERSTOWN, MARYLAND; 1444 Washington, HUNTINGTON, W. VA.; 302 Bay Street, TORONTO, CANADA

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EDITORIAL

"Gen. Billy Mitchell preached for a separate air force but we still haven't got it. . . . It would hasten mass production and do away with similar yet different designs which constitute a great waste."—Maj. Gen. Harold L. George, commanding the Air Transport Command.

Kill the Lea Bill

IF you want aviation to grow after the war for the security of this nation; if you want air service in every American community, vote NO on the Lea Bill.

This measure, 121 pages long, is pending in the House. It would extend to all phases of civil regulation the same tight controls that strangled the growth of air transport.

We entered the war with only 350 planes on all our domestic airlines, while Hitler had thousands of transport aircraft and South America had more than twice the route mileage and airline stops as did the United States. Why? Because the airlines had to enter long hearings before they could start any new service.

By contrast, despite many discouragements, the private pilots and flying schools had 25,000 planes at the outset of this war, a "grasshopper fleet" which has served our country well. Why? Because private flying was only under safety regulation and not economic regulation. A man who wanted to fly from here to there could fly.

If the Lea Bill passes, Federal control of all phases of civil aviation will be absolute. There is no present need of it because the Army now has full powers as is proper in wartime. Private flyers have gladly surrendered their privileges for the duration.

If you pass this bill because some lobbyist favors it, it will be a bitter betrayal of those loyal Americans to whom the freedoms for which they are fighting include the RIGHT TO FLY. Perhaps there are some features of the bill which should pass. But to jam through this complex measure now without hearing those who will be most affected would be a STAB IN THE BACK to every airman in the service.

* * *

MANY thousands of these men are going to want jobs in aviation when they come back from bombing Tokyo. Considering that there are now only 166 planes on the domestic airlines and close to 100 times that many planes still in private hands, it is easy to see where their flying opportunities will be.

If you pass the Lea Bill and retard the expansion of light plane development too, *are you going to be able to look those lads in the eyes?*

Defer this measure and aviation can grow with a minimum of Federal encouragement; a minimum of taxpayers' expenditure. Vast networks of feeder lines will come into being almost over night to serve every hamlet with air mail, passengers, cargo and express. Door to door air deliveries instead of trips only between major air terminals will be possible. A healthy aircraft industry and a vast reserve of skilled pilots and technicians will be maintained.

These things are fundamental to future progress and security. How can Congress attain them? Just give aviation a chance. Forget the Lea Bill. Remove existing controls, if you will, but do not add to them. Not ever. This we earnestly petition. The boys out yonder will thank you for it.

Let's Stick to Facts, Mr. Pearson

IT is difficult to see the slightest useful purpose to be gained by the recent outburst in his syndicated newspaper column by that "Pearson person" (to use Henry Ford's words) against the glider program.

Disparaging statements regarding the Waco-designed Army glider now in production in many plants can do no good; they can do severe damage to morale of workers and pilots alike even if the effects upon the public are entirely disregarded.

Said Pearson: "When one glider manufacturer asked Navy permission to make the Navy-type glider for the Army, the Navy refused." Such an assertion does not deserve serious consideration. We believe that if it were decided by the High Command that the Navy had a better glider than the Army for Army purposes, that design would have been adopted for the Army, even if it were true that Navy incompetents said no.

* * *

THE Waco glider has been standardized for all AAF contracts. Expert wood fabricators have contracts to build it or its components, and the pilots who have flown it in the combat zones can give the lie to Pearson's disparaging remarks about it.

Army officers who were in the thick of the Sicilian campaign have said that Wacos speeded up the advance materially. Richard du Pont, head of the glider program for the Army, recently returned from an investigating trip to the Mediterranean theater, has nothing but praise for the work the Wacos are doing—and he knows his gliders.

As a matter of fact the Waco glider is also being used by the Navy, and the British have adopted the design because of its performance in battle areas.

Pearson didn't mention these facts. He wanted to create a sensation so he evidently decided to out-Truman the Truman Committee. In our opinion he has been guilty of some bad reporting, and the war effort has been hurt by his ill-advised meddling.

AN AIR UNION FOR ACTION

If the Industry Is to Cope Successfully with Its Peacetime Problems, All Groups Should Be Combined to Present a United Front

WHATEVER may be said about air power, air transport and the aeronautical industry, it may not be said that aviation has fallen short of the optimistic development predicted for it. It may not be held that any sound claim made as to what can be accomplished by or with aviation has failed to be justified. Whatever doubt may still exist in the minds of those who are slow of conviction about the correctness of the theories of Douhet and Mitchell would be dispelled if the unconvinced had the facts.

No matter what the viewpoint taken on the aviation industry and the airplane, the growth of the former and the usage and effectiveness of the latter impress the imagination and tax the credulity. In sixty months, the expansion of aircraft industries and of aviation has been so great and so rapid that we have no real measure of their dimensions.

The Peacetime Battle

If there should be an inclination to assume that an industry capable of winning the battle of design and production forced onto it by the war should also be able to win its peacetime battle, then one should take time out to survey the situation most carefully. Without underestimating anything accomplished to date, anyone at all informed realizes that there is no comparison between the wartime problem and the forthcoming peacetime problem. When peace comes, the industry's problem will be so infinitely complex that any hastily contrived solutions may fail entirely. Such a failure could easily cost the industry its autonomy.

The very stature of the present aviation industry makes it a force to be reckoned with, when the time comes to readjust to peacetime requirements. It is by no means just a question for the stockholders and directors of aviation concerns, large and small, to decide what each can do to get some business. There is no easy formula nor simple solution, but the problem is not one that defies intelligent action.

But it should be borne in mind that intelligent action also means "concerted action", without which the industry's interests will be severely prejudiced. Such action requires the creation of a body constituted by and formed out of all existing air associations, chambers of commerce, institutes and similar groups; supplemented by individual membership open to anyone interested in aviation. There is no reason why action by such a body should be cumbersome, since through its nature it would have to be guided by the leaders of the industry. Naturally, one of its strongest features is that it provides a vehicle for a united front.

These peacetime problems are not elusive. Among the most apparent and probably in order of importance are those relating to: (1) retention of autonomy; (2) aircraft as the first line of defense; (3) adoption of latest technical improvements; (4) equitable provisions for foreign routes for air transport companies capable of operating them.

¶ When peace comes, the industry's problems will be so complex that any hastily contrived solutions may fail entirely.

¶ It is not too early to prepare factual material to refute any claims that the national interest would be served through federalization of the industry or any part of it.

¶ Without concerted action much good that has been accomplished may be lost.

¶ An Air Union could present a united front against attack from any quarter.

It is not too early now for industry to prepare factual material to refute any claims that the national interest would be served through federalization of the industry or any part of it. Sufficient material exists and only requires putting together, but conclusions must be intelligently drawn and supported without dissension by representatives of the entire industry. Unless such means are provided and made use of, it is not impossible that forces tending to direct aviation toward State control will succeed while the industry stands inarticulate and impotent.

Then, too, representatives of the entire industry must direct a determination whether aircraft is to be the nation's first line of defense. If this is to be, then an early recognition of the fact is important in order to lay out schedules for peacetime manufacture.

As to technical improvements, there are many that have passed the experimental stage and are waiting only for the opportunity to be incorporated into airplanes, engines and accessories. The industry has ready many vastly improved mechanisms for post-war flying, all of which relate to safety, economy or ease of operation.

Much controversy has arisen over foreign air routes as to who shall have them, where and under what conditions they may exist, and whether and how they shall be subsidized. International conditions complicate the problem, and it is further complicated by internecine disputes. Perhaps this is natural and it may even be healthy.

If the industry is to solve these problems through concerted action, it is needful to examine more closely into the structure and function of a united group. It has been mentioned that this group would be a body formed out of existing air associations, chambers of commerce, institutes and similar groups supplemented by individual membership open to anyone interested in aviation. When chartered and incorporated, it would become an Air Union.

United Front

Without it, concerted action is almost impossible and, without concerted action much good that the industry has accomplished may be lost. An Air Union could take such concerted action and could, at the same time, undertake a most needed educational program. It could prepare, collate and disseminate information about aviation in all its phases. And most important of all, it could present an authoritative and united front as a bulwark against attack from whatever quarter it might come.

An Air Union is indispensable to concerted action.

MAKE THEM MORE AND MORE AUTOMATIC

TO INCREASE THEIR FIGHTING POWER ★★★

White-Rodgers automatic temperature modulation equipment relieves pilots for greater concentration on fighting power by providing completely automatic control of:

1. **Engine cowl flaps (both air and liquid cooled).**
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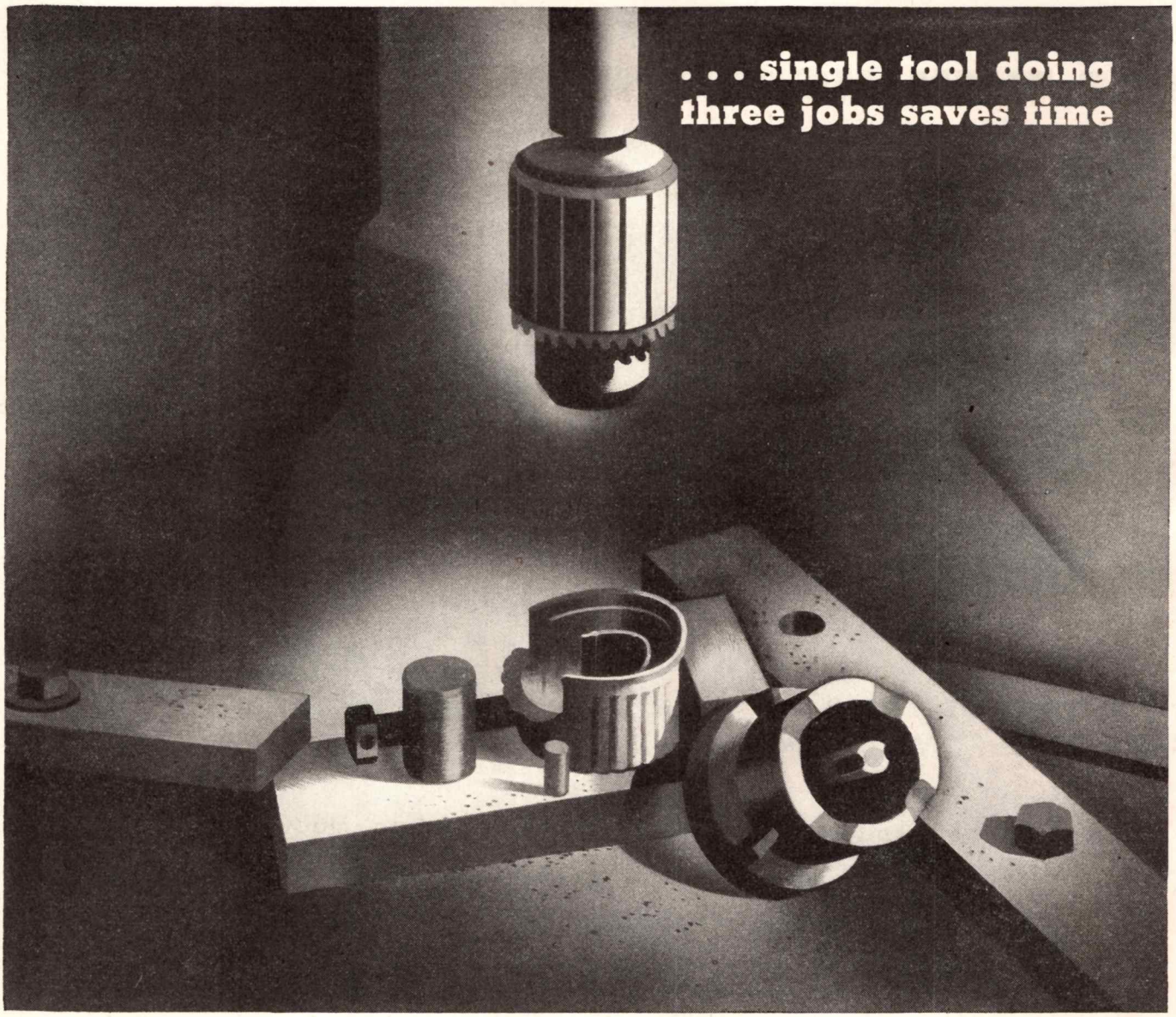
Upon request, engineering data will be furnished to manufacturers requiring controls for the above or other temperature control applications.

WHITE-RODGERS ELECTRIC CO.

SAINT LOUIS **MISSOURI**

LET'S GO! U.S.A. · KEEP 'EM FLYING!

DOUGLAS SBD, DAUNTLESS
OFFICIAL PHOTO COURTESY U. S. NAVY



Information supplied by an Industrial Publication

One of the best ways of expediting machining is the use of tools that make several cuts simultaneously. True, such tools must usually be specially designed, but the time saved more than compensates for the effort of developing them.

A tool developed to do three operations simultaneously on an aluminum die casting is a good example. It is a combination drill, miller and facing cutter.

The drill which cuts flash from the center hole is in the middle. It is surrounded by a four-tooth hollow mill which removes push-out pins at the bottom of the annular recess between the inner and outer walls. Above the mill, on a flange, are four cutters that remove flash and face the top edge of the casting.

All of these operations are performed with the tool in a drill press spindle, the work being held by a simple fixture. The time saving between this method, requiring a single set-up and a single stroke of the drill press spindle, and the use of three set-ups and three tools is obvious.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

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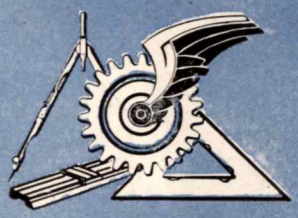
AERO DIGEST'S

Aviation Engineering



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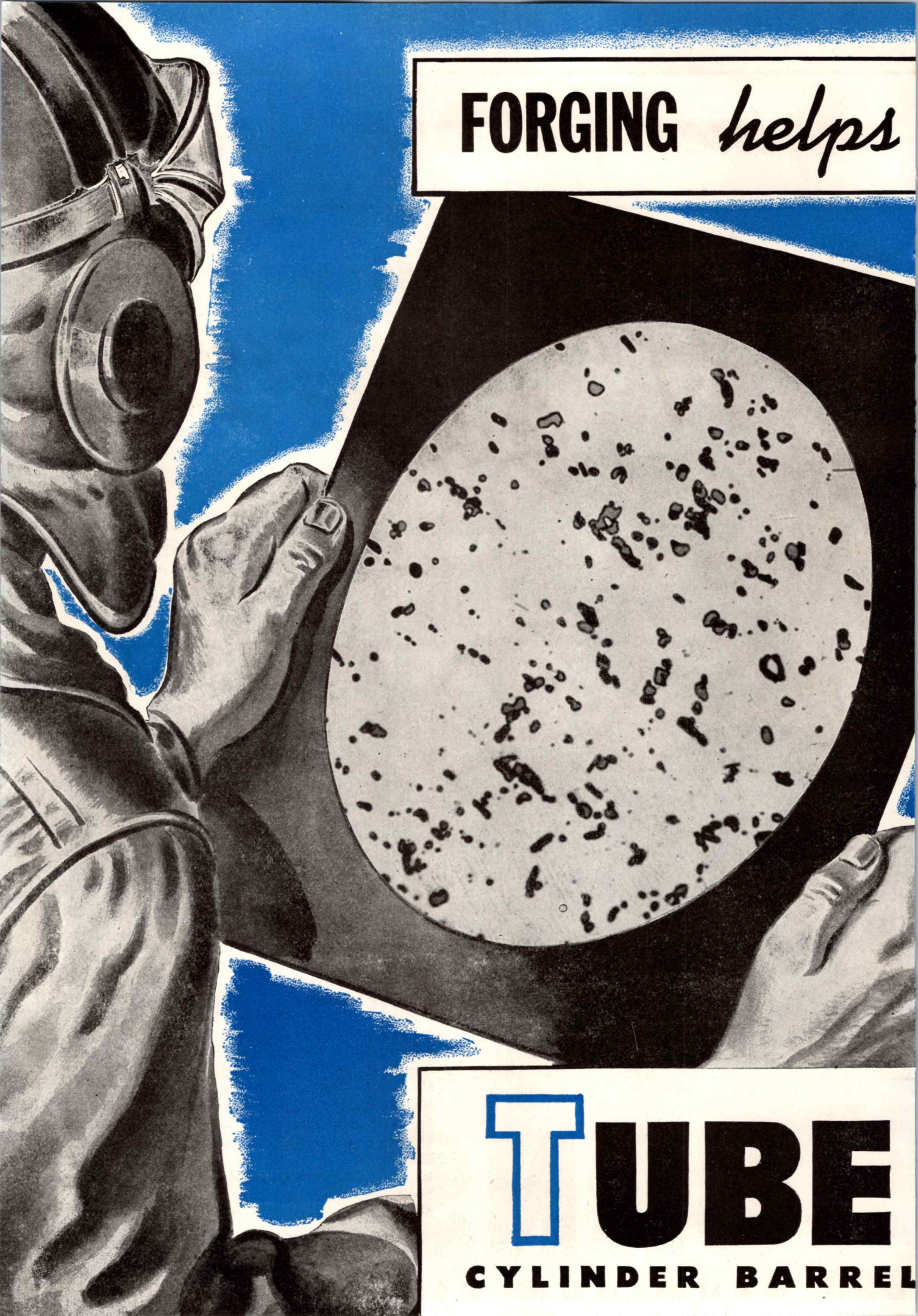
FORGING *helps*



TUBE

CYLINDER BARREL

engines perform better!

THE enlarged photomicrograph* shown opposite is an actual 1000-X magnification of metal structure in an aluminum piston *forged* by TUBE TURNS.

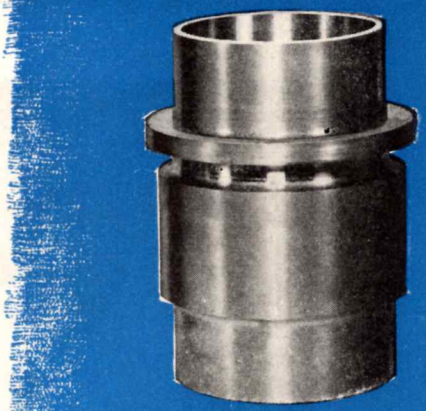
The pilot is not a metallurgist, yet he realizes that *excellent metal structure* like this is important to his success.

No engine part demands more production skill than *pistons* and *cylinder barrels*. Accurate forging, coupled with skillful *heat treating*, gives these vital parts the exact hardness and metal structure so necessary to quality and endurance.

Years of forging "know how" and the most modern equipment enable TUBE TURNS to set an enviable record in forging these crucial parts with the *perfection* and *speed* demanded by engine manufacturers — so that American planes and their crews may perform better!

**This Tube Turns photomicrograph is of a sample of 18-S aluminum alloy, quenched in boiling water after soaking at 960°F. for 6 hours. It was then reheated to 340°F. for 8 hours. Etched in Kellar's reagent for 15 seconds. Magnification 1000-X.*

TUBE TURNS (Inc.), LOUISVILLE, KY.



A Small Tube Turns Steel Cylinder Barrel Forging.

A Tube Turns Aluminum Alloy Piston Forging.

A Large Tube Turns Steel Cylinder Barrel Forging.

TURNS

Specialists in producing difficult precision forgings from various steels, aluminum, and other metals.

and ALUMINUM PISTON FORGINGS

The Foreman and the Manpower Problem

● Foremost among the many problems besetting American industry in its herculean effort to out-produce itself in behalf of the war effort, is that of manpower. For the solution of the practical day-to-day aspects of this problem, of those multifarious aspects which show themselves at the machines and along the assembly lines of every manufacturing plant in the land, no single group is more responsible than the foremen.

Human Relations Problems

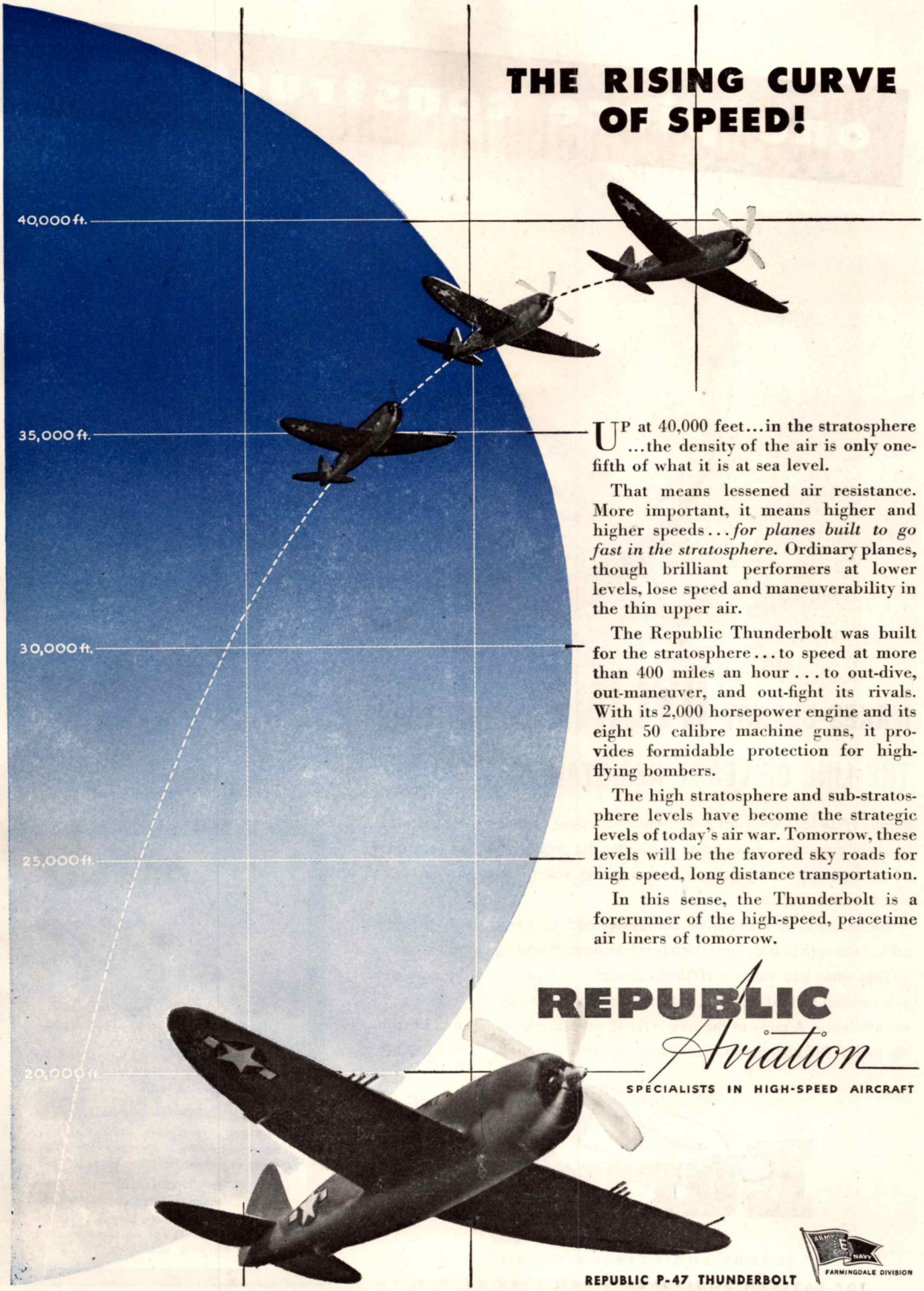
Recognition of this, and of the fact that successful foremanship is preeminently identified with a broad understanding of human relations, has led the Pratt & Whitney division of United Aircraft to frame a document highlighting characteristic problems of the foreman — together with their solutions. Distilled from the experience of the company's staff, this material has been organized and produced in the form of a motion picture entitled "It's Our Job," which is being used to supplement the program of education in foremanship developed by H. C. O'Sullivan, director of training for United Aircraft.

The foreman's problems cover a wide range, from those arising out of the more obvious considerations of wartime, and reflecting themselves in

(*Continued on page* 157)

At top: The foreman should establish a friendly relationship with the worker at the outset. Here he introduces a newcomer to the group leader. Center: The man who thinks he deserves a raise should be given even-handed justice. Here the foreman backs his refusal by pointing out applicant's poor production record. Below: Foreman should avail himself of company training school, to improve ability of his workers

THE RISING CURVE OF SPEED!



UP at 40,000 feet...in the stratosphere ...the density of the air is only one-fifth of what it is at sea level.

That means lessened air resistance. More important, it means higher and higher speeds... *for planes built to go fast in the stratosphere.* Ordinary planes, though brilliant performers at lower levels, lose speed and maneuverability in the thin upper air.

The Republic Thunderbolt was built for the stratosphere... to speed at more than 400 miles an hour... to out-dive, out-maneuver, and out-fight its rivals. With its 2,000 horsepower engine and its eight 50 calibre machine guns, it provides formidable protection for high-flying bombers.

The high stratosphere and sub-stratosphere levels have become the strategic levels of today's air war. Tomorrow, these levels will be the favored sky roads for high speed, long distance transportation.

In this sense, the Thunderbolt is a forerunner of the high-speed, peacetime air liners of tomorrow.

REPUBLIC *Aviation*

SPECIALISTS IN HIGH-SPEED AIRCRAFT

REPUBLIC P-47 THUNDERBOLT

ARMY NAVY FARMINGDALE DIVISION

one-piece construction...

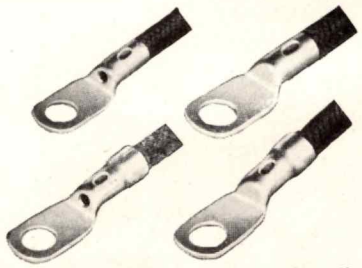
MAKES BURNDY HYLINE CONNECTORS

THE LINE OF LEAST RESISTANCE!

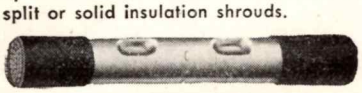
Burndy HYLINE Connectors are formed from pure copper in one-piece . . . because *one-piece* construction eliminates the probable added resistance of an extra contact surface . . . thus giving you a *more positive, more efficient* connection.

Furthermore, this exclusive Burndy method of construction provides *added strength* in a design which is *more compact* and *lighter* in *weight*.

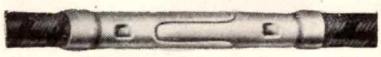
Thus when you indent a HYLINE connector to a conductor you are sure of a connection that is strong, extremely compact, and of maximum electrical efficiency. A copy of the new HYLINE catalog illustrating and describing all HYLINE connectors, will gladly be sent on request.



HYLUG . . . *one-piece* terminals, for all wire sizes from No. 29 up, with either open or closed backs, with or without split or solid insulation shrouds.



HYLINK . . . *one-piece* end to end connectors for all wire sizes from No. 29 up, with or without insulation shrouds.



LINKIT . . . the famous Burndy separable connector which has no loose or extra parts. For wire sizes from No. 22 up.

Headquarters for connectors

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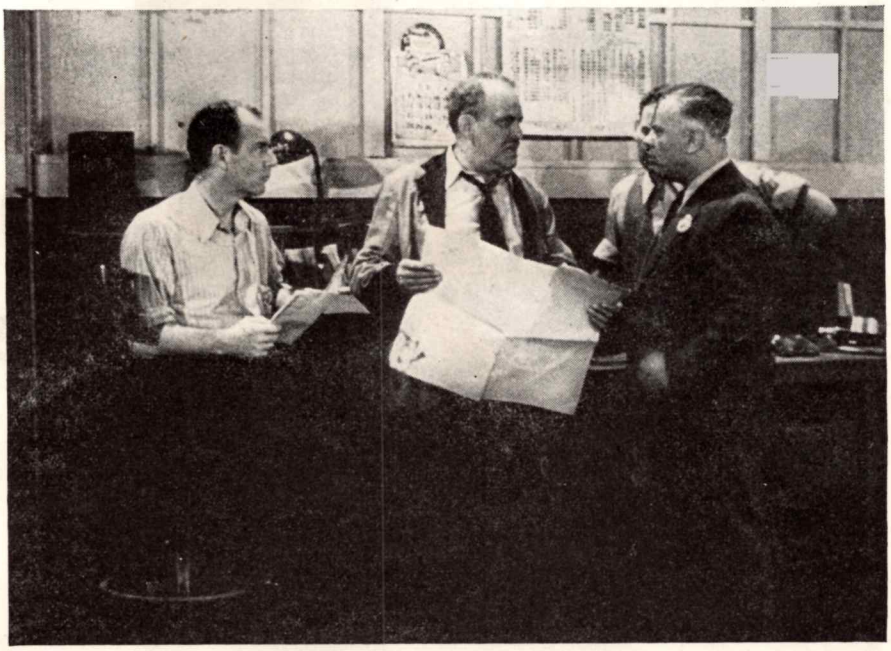
(*Continued from page* 154)
such routines as the discouragement of horseplay and practical jokes, to those based on fundamental human values such as are reflected in the building of confidence in himself among his employees, between himself and foremen of other departments, and between himself and management. The solutions of all these problems add up to *cooperation*, and it is an active consciousness of this that makes a foreman's job a success or a headache.



Cooperation with fellow-foremen is essential. Here the second-shift foreman takes the first shift to task for leaving incomplete information about a new set-up

Handling the Newcomer

The foreman's sense of responsibility is subjected to an acid test whenever a new operator walks into the department. In the rush and confusion of a busy war plant, for example, when a new recruit wanders in too often he may be referred by the harassed foreman to an equally harassed group leader. He also, in turn, may take the easiest way out and leave the new man to watch a regular operator on the job —one who is too busy keeping up with production to stop and explain the machine or its work. The net result of such treatment is a dissatisfied worker who will hate his job before he gets started.

The proper handling of this situation is of cardinal importance. It becomes plain that the problem can be successfully worked out even in the midst of confusion, if the foreman takes the time necessary to let the new man know that his boss is also his friend. In this approach to the problem, he spares the extra moments needed to ask the new man about his past experience in a friendly and interested way. He lets him know that he is welcome and that he wants him to be a success in his job.

He will then introduce him to the group leader and explain that although it is impossible for him to start the newcomer himself, the group leader will take good care of him. The beginning worker will perhaps now meet the timekeeper, who will explain his time card and the time clock procedure, seemingly a small matter, but one that can prove very baffling to one who has had no former experience in checking in and out.

Next, he will be placed with an experienced operator on the same job where the getting acquainted process can be combined with visual instruction. There are a lot of details in techniques which the new man can learn from watching the man who is used to the tricks of the machine.

Finally he starts running the job himself. He's hesitant and self-conscious and needs encouragement, but the group leader sees him through until he gets into the swing of things. Once he's started right, he'll be apt to stay in the right channel. He knows he's one of the family and that his coworkers, as well as his boss, are interested in seeing him make good.

When example has been set by foremen, workers gladly display their badges at plant gate

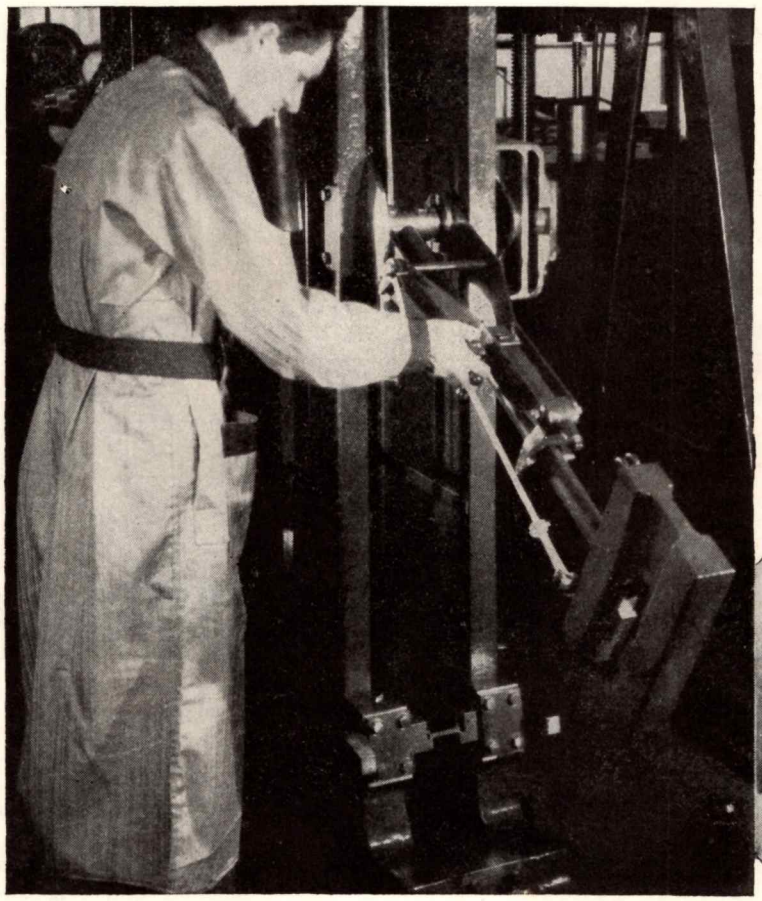
Physical Condition Important

Another matter which the well-trained foreman keeps in mind is the physical qualification of his people. That husky young fellow who appears in the best of physical condition would probably be at a battlefront or in a training camp if he could qualify. Men with 4-F classifications don't go around announcing their disabilities any more than an over-draft age worker will admit that he isn't quite equal to some heavy lifting job that a thoughtless foreman may expect of him.

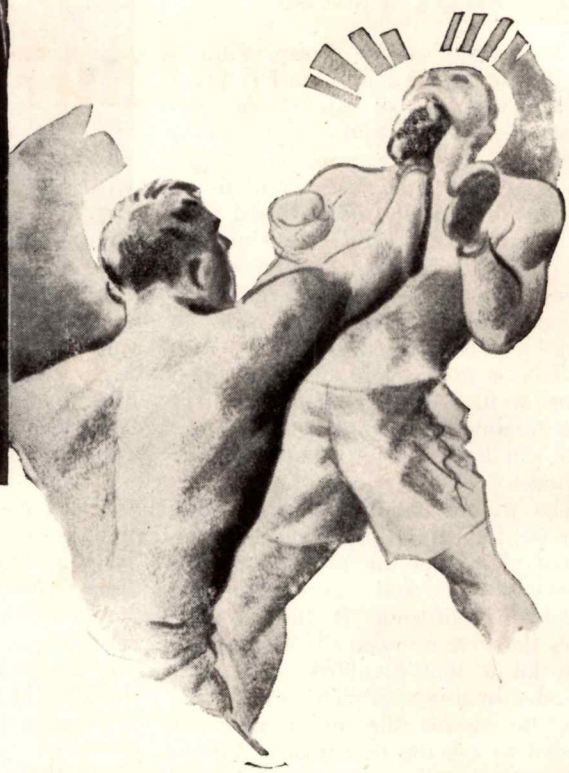
There is a high percentage of women workers in factories today, and the foreman must take their temperament and physical capabilities into account. A quick look at the medical history of the individual man or woman, or a check-up with the medical department, in all cases where new assignments involve changed physical routines may avoid an injury case and the loss of valuable manpower.

Cooperation is the watchword all down the line. Even the stock chaser,

(*Continued on page* 272)



How to give a SOCKET SCREW the old "one-two"



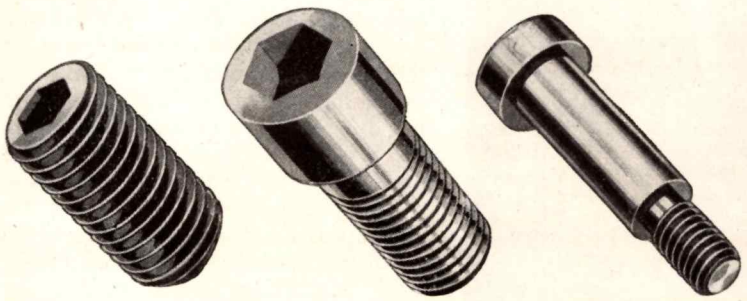
Steel-fisted slugger makes sure Parker-Kalon Socket Screws can take bigger shock loads than they'll ever meet . . . . .

There's no b'guess and b'gosh about the shock load resistance of Parker-Kalon Socket Screws. The Olsen Universal Impact Tester in Parker-Kalon's Quality-Control Laboratory can deliver a "haymaker" equal in force to a one-pound weight dropped 264 feet, creating tension, shear, and bending stresses far above normal. Only screws that have stamina to spare can survive this rigorous test.

Measuring shock load resistance is only one of the 16 tests and inspections that are made to assure the *dependable* performance of P-K Cold-forged Socket Screws. This rigid routine of quality control eliminates the "doubtful screws" – screws that *look* all right, but some of which fail to *work* right. Socket Screw users need this protection today more than ever. Specify "Parker-Kalon" next time you order . . . it costs no more. Parker-Kalon Corp., 190-196 Varick St., New York 14.

This 16-point "Quality-Control" protects P-K Socket Screw Users

1–Chemical Analysis. 2–Tensile Strength. 3–Ductility. 4–Torsional Strength. 5–Ability to take Shock Loads under Tension. 6–Resistance to Shock Loads under Shear. 7–Hardness. In addition, there is a rigid inspection of these essentials: 8–Head Diameter. 9–Head Height. 10–Concentricity of Head to Body. 11–Socket Shape. 12–Socket Size. 13–Socket Depth. 14–Centricality of Socket. 15–Class 3 Fit Threads. 16–Clean Starting Threads.



PARKER-KALON
Quality-Controlled
SOCKET SCREWS

ENGINEERING FUNDAMENTALS of AIRCRAFT FINISHING

A. L. JOHNSON and JOHN J. OUDHOFF

● The increasing use these days of specification finishing materials has created many new problems which the aircraft manufacturer will do well to recognize. The finishing engineer who familiarizes himself with the formulation and physical properties of his materials is in a better position to solve these problems and to improve his production record. Much has been written concerning protective coatings finishing systems as used in the aircraft industry, but little about the physical characteristics of the materials.

Let us take up first the subject of wood finishing, beginning with a consideration of the kinds of wood, their respective natures, and the types of finishes to be used on them. Resinous bonded plywood, consisting of mahogany, birch, gum, fir, or spruce, is generally employed. Since all woods are porous and some, such as mahogany, have an open grain, filling is required in order to obtain a smooth finish.

Properties Required of the Wood

Moreover, the wood must be treated so that the finished part will be impervious to moisture and afford a minimum of weight. It must be able to withstand the action of high-test gasoline, de-icing and hydraulic fluids, and at the same time be flexible enough to allow for sudden changes in temperature. In addition, it must meet many requirements that are not called for in other finishing schedules.

We begin by sealing the wood, using a material conforming to specification AN-S-17. Dipping is always preferable, but where this is impractical brushing should be employed. The "sealer" used here is no recent development, one similar to it in formulation having been used on some of the later model Fokker plywood wings. The term "sealer," by the way, is hardly a suitable designation for this type of finish. Words such as "primer," "flexor," "preservative," or "moisture repellent," describe it more clearly in terms of performance and function.

A sealer is popularly thought of as a coating *on* the wood, designed to prevent penetration. The chief purpose, actually is to *penetrate* the wood deeply until it becomes part of the wood itself, breathing and flexing with it, yet preventing undue moisture absorption and retention. It provides a binding or cementing foundation for the finish that goes over it, and should adhere to the wood as well, if not better, than it does to the finish.

Having properly sealed the wood, attention is directed next to filling the grain, though in some systems filling is done before the sealing operation. In the latter case the sealer actually penetrates through the porous filler into the wood, acting not only as an impregnator but also as an additional binder for the filler. Moreover, the application of the sealer as a second coat permits an easier operation in the wiping off of the filler, since the volatile portion of the filler does not penetrate into the dried film of the sealer. Before

JOHN J. OUDHOFF is at present connected with the Eastern Aircraft division of General Motors, as an experimental engineer in charge of the development and application of new finishing materials for aircraft. Widely experienced in chemical engineering, Oudhoff has been associated as a research chemist, with the Sherwin-Williams Co., the Martin Varnish Co., and the Standard Varnish Co.

A. L. JOHNSON has been associated with the Murphy Varnish Co., of Newark, N. J., as a research chemist, ever since his graduation in 1925 from Pratt Institute, where he majored in Industrial Chemical Engineering. During the past several years Johnson has been director of all research and service work pertaining to aircraft finishes, a field in which he has become a recognized technical authority.

attempting to use this method, however, the manufacture of the finishing materials involved should be consulted to determine if the sealer and filler are compatible.

If open grain wood is to be finished, the use of a surfacer will be required —one conforming to Army specification 14115. The surfacer should be sanded well with 280 or 320 paper to render the surface smooth, and to remove excess material from the wood. This should be followed by a top coat of enamel. Due to their better moisture resistance, synthetic enamels are generally used. Army specification 14109 or Navy specification M-543 are most satisfactory. Enamels need not be sanded since they are applied over wood filler and properly sanded undercoats.

Strict adherence to the methods and materials set forth in the above will result in a finish possessing maximum durability and moisture resistance.

Internal wing structures, due to the excessive amount of moisture condensed upon them, must also be finished, but because of their interior situation they present a serious mechanical and physical problem. One difficulty that is encountered in finishing these parts is that the sections to be glued must first be protected in some manner. A good bond cannot be obtained if the glue is applied over wood that has been coated with sealer or varnish. The need for a sealer having good adhesion to glue is being given consideration by the chemist. The most popular method here is to tape the part to be glued, then to apply the finish—which should consist either of two coats of sealer, or of one coat of sealer and one of spar varnish. When the finish is dry the tape is removed and the parts glued.

Application of Sealer by Brushing

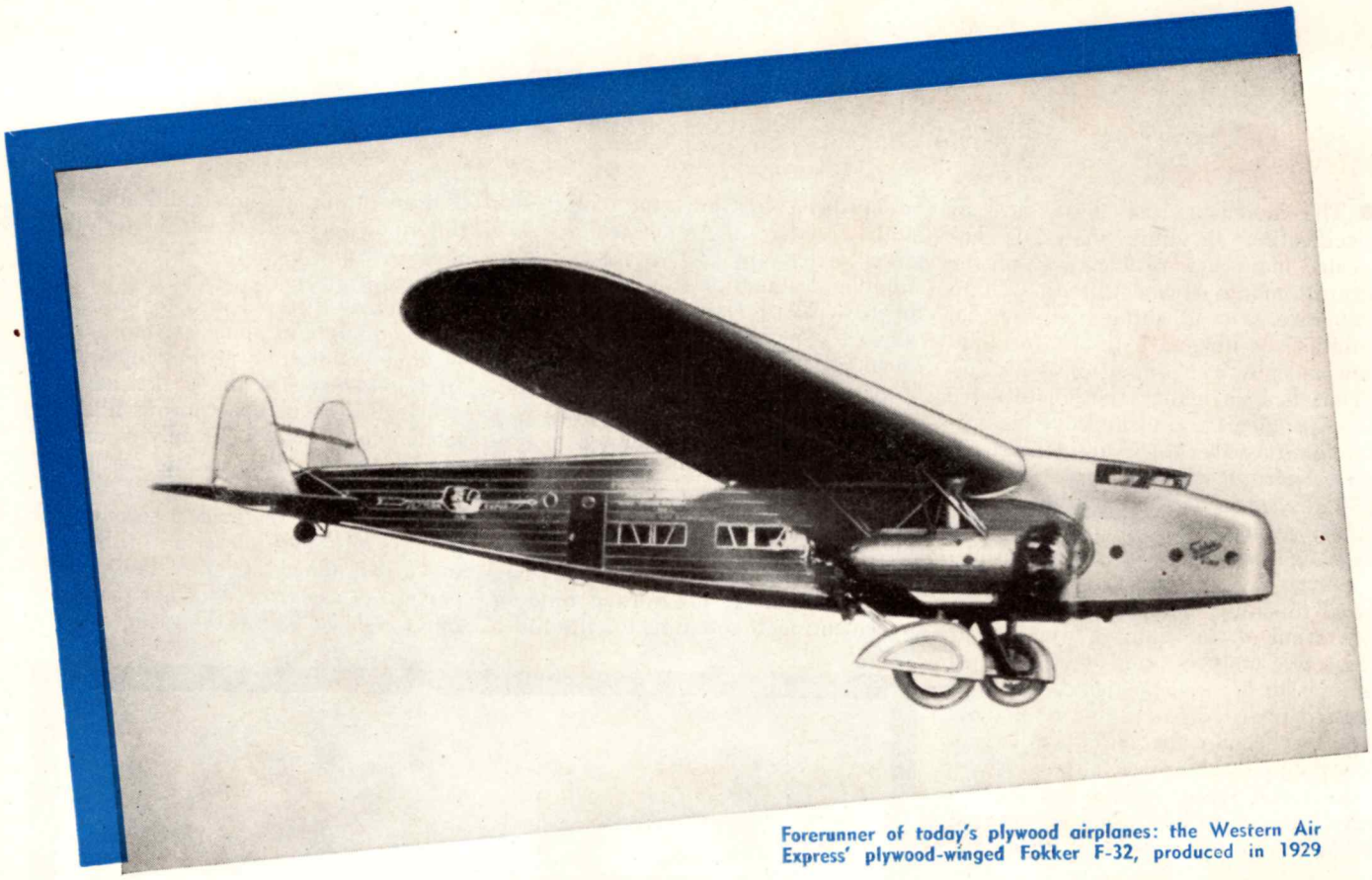
Since the finishing of the interior must be done after most of the structural work has been completed, the most practical method is to apply the sealer by brushing. Dipping is generally impractical, due to trapping of excessive finishing materials within the wing. Spraying in most cases is also impractical due to obstructions, such as braces, ribs and spars, within the wing.

Let us turn now to fabric finishes and to the problem which they present. Sometimes it is asked, "Why apply so many coats of finishing materials to fabric, when so few are used on other surfaces?" Again, "If final coat finishes contain as high as 40% solids, why not increase the solids of the dope to this amount, thereby reducing the number of coats required to produce the desired fullness?"

There are certain principles involved in the answers to these questions. Thus, a dope, whether it is nitrocellulose, cellulose acetate, or cellulose acetate butyrate, is composed of cellulose derivatives, plasticizers, and volatile matter. We are interested in the last ingredient only insofar as it affects the application of the dope, for it is the medium by which the solids are transferred from the container to the fabric surface. Its composition controls blushing, orange-peeling, pin-holing and drying. The portion of the film in which we are most interested is the non-volatile substance which rarely exceeds 14% in a quality product. Specification AN-TT-D-514, for example, contains a minimum solid content of 10%. The use of 15 to 20-second nitrocellulose is specified in its formulation. If the solids are increased, using the specified nitrocellulose, the result is merely an increase in the viscosity, necessitating additional reducer to return it to practical spraying viscosity.

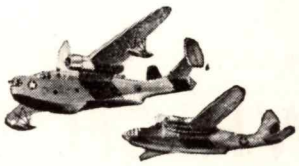
Why not use lower viscosity nitrocellulose in the formulation of the product? All formulators of quality finishes have learned through experience that dopes so formulated have poor tautening properties, are not flexible, and have indifferent durability. To answer this question properly, perhaps the difference between high

(*Continued on page* 165)



Forerunner of today's plywood airplanes: the Western Air Express' plywood-winged Fokker F-32, produced in 1929

Womanpower and Black & Decker Tools



--Vital production team for Aircraft Plants

"Women workers are doing a good job with Black & Decker Portable Electric Tools at our plant" . . . "They handle these tools with skill in remarkably short time" . . . "Taking the place of men in many important assembly jobs" . . .

Woman operator handling her Black & Decker Portable Electric Scrugun with speed and skill at a busy aircraft plant.

These are typical of war producers everywhere who (1) rely on Black & Decker Tools to do all kinds of mass production jobs *faster* and *better*, and (2) count heavily on the skill of women war workers to use America's favorite mass production tools *faster and better*.

The pictures here show just a few of the jobs that women aircraft workers are doing with Black & Decker Tools. In *all* aircraft production . . . parts, assemblies, sub-assemblies, engines, armament . . . women are using these Drills and Tappers, Screw Drivers and Lectro-Shears, Sanders and Grinders to help "keep 'em flying." And . . . compact, husky, *easy-to-handle* Black & Decker Tools really give these women "power" to do a man's job. For the engineering soundness and "know-how" that's built into these tools enables new, inexperienced women workers to become *skilled* operators and attain top production speed in a comparatively short time.

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by the hundreds are needed all along the production front to fill essential jobs. If you know any women who are qualified to free men to fight, urge them to apply at once to their local U. S. Employment Office.

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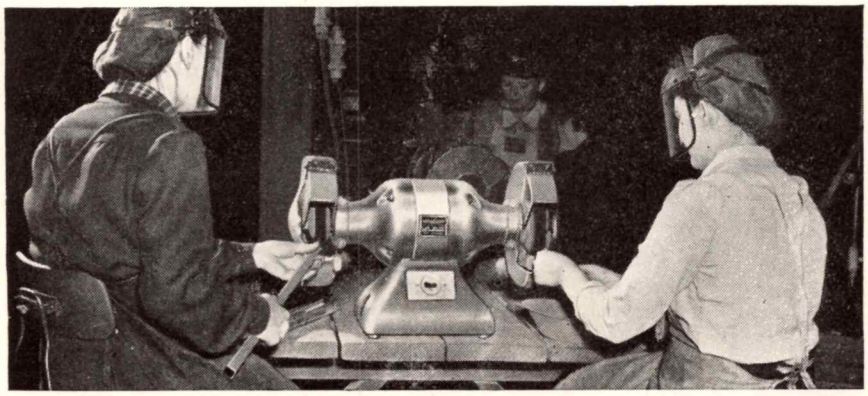
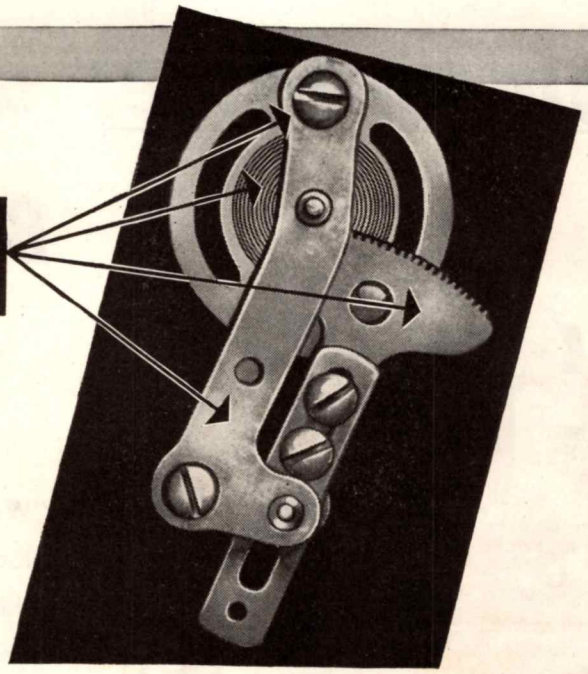


Women team up at Black & Decker Bench Grinder to keep plane parts rolling. One operator (left) brushes aluminum angles, while operator at right wire-brushes aluminum rods.

WHICH **Stainless Steels** for these parts?

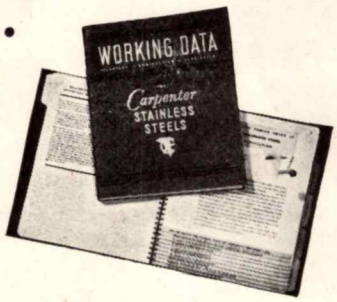


Here Is How Carpenter Can Help You Find the Answers To Your Stainless Selection and Fabricating Problems . . .

• When selecting a Stainless Steel to meet your particular design-engineering requirements—or when you could use fabricating assistance—take advantage of Carpenter's diversified experience with Stainless problems.

To help you quickly solve new and difficult Stainless design or fabricating problems, here is easy-to-use information about several Carpenter Stainless Steels. These straight chromium Stainless Steels, widely used in the form of strip are not hardenable by heat treatment. They provide ample corrosion resistance for many applications, plus special properties such as scale resistance, electrical resistance and extra ductility. Future messages will give you useful information on other types of Stainless to meet specific conditions in service. Meanwhile, for further help, get in touch with your nearby Carpenter representative. He can provide real assistance, and will keep you in close touch with our Metallurgical Department.

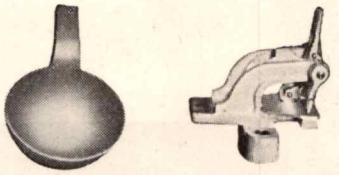
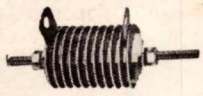
Use this production-engineering help...



"Working Data for Carpenter Stainless Steels" will provide you with much useful information on selection and fabrication—to help you get the most from every pound of Stainless. Use it to help you plan the use of Stainless for today's war jobs, and for tomorrow's peacetime products. This 98-page book is offered free to Stainless users in the U. S. A. For your copy, just drop us a line on your company letterhead.

more than corrosion resistance

The Carpenter Steel Company, 116 Bern St., Reading, Pa.

	DESCRIPTION	PHYSICAL PROPERTIES
For Products That Need Specific Corrosion or Scale Resistance... *Carpenter* **STAINLESS No. 3** **(Type 443)** ➡  *Carpenter Stainless No. 3 gives longer life to products ranging from clips used on textile machines to ladles for molten non-ferrous metals.*	● This grade compares favorably with 18-8 type Stainless in both corrosion and scale resistance. It resists all ordinary corrosive conditions including salt spray, foodstuffs, most organic chemicals and many fused salts. Not subject to intergranular corrosion from hot working or welding—it is recommended for continuous high temperature service. Carpenter Stainless No. 3 cold rolled strip is very ductile, ideal for complicated press work. In bar form, it is easier to machine than the non-free-machining 18-8 types. Used for furnace parts, soot blower tubes, stirring rods and other products demanding specific corrosion or scale resistance, this Stainless is available in the forms of forging billets, tube billets, hot rolled and cold drawn bars, centerless ground bars, wire and strip.	Carpenter Stainless No. 3—Type 443—(Carbon .15%—Chromium 20.00%—Copper 1.00%) **Specific gravity—** 7.69 **Melting point—** Approximately 2500°F. **Specific heat—** .061 Cal. per deg. F. **Thermal conductivity—** .070 C.G.S. units at room temperature. **Coefficient thermal expansion—** .0000055 average 60°F. to 1500°F. **Specific electrical resistance—** 410 ohms per cir. mil ft. at 68°F. Temperature coefficient—(68°F. to 1300°F.) .00060 per deg. F. **Tensile properties—** Does not respond to heat treatment. In annealed condition its ***Tensile Strength*** is approximately 90,000 lbs. per sq. in.
If You Need Uniform Electrical Resistance . . . *Carpenter* **STAINLESS No. 1-JR** **(Type 406)** ➡  *The uniform electrical resistance and easy forming properties of No. 1-JR are essential in this edge-wound resistor coil.*	● This grade has a high specific electrical resistance and low temperature coefficient. Carpenter Stainless No. 1-JR (Type 406) is the most popular resistance material in the "Stainless Series". No. 1-JR can be hot forged or cold formed. Flat sections are especially annealed to wind smoothly edgewise into coils. It is easily punched or blanked. Usually supplied as hot or cold rolled strip, No. 1-JR is also available in the form of hot rolled or cold drawn round wire.	Carpenter Stainless No. 1-JR—Type 406—(Carbon .10%—Chromium 13.00%—Aluminum 3.50%) **Specific gravity—**7.352 **Specific heat—** 68°F.—.063 Cal. per degree F. 400°F.—.074 Cal. per degree F. 950°F.—.095 Cal. per degree F. **Coefficient thermal expansion—** .0000080 average 68°F. to 1475°F. **Specific electrical resistance—** 680 ohms per cir. mil ft. at 68°F. Temperature coefficient—.00016 per deg. F. between 68°F. and 1100°F. **Elastic modulus—**29,000,000 For tensile properties at elevated temperatures, see the working data book described on the opposite page.
Faster Output—Fewer Rejects With This Stainless Strip . . . *Carpenter* **STAINLESS No. 6 (Type 430)** ➡ *Intricate shapes and sharp radii present no problems with Carpenter Stainless No. 6. It is easy to stamp or blank this soft, ductile strip.*	● You won't find a Stainless Strip that is easier to fabricate. Carpenter Stainless No. 6 is ideal for making blanked, stamped or formed Stainless parts. This Stainless provides positive resistance to corrosion from atmosphere, mine water, steam, carbonic acid, crude oil, blood, alcohol, etc. Carpenter Stainless No. 6 is used extensively in the forms of cold rolled strip and cold drawn wire. In the lighter gauges, often used for trim, it is furnished with a very smooth bright finish that resists scuffing and wear. For machined parts made from forgings or bar stock, Carpenter Stainless No. 6-FM provides free-machining properties.	Carpenter Stainless No. 6—Type 430—(Carbon .10%—Chromium 17.00%) **Specific gravity—**7.71 **Coefficient thermal expansion—** .0000065 average between 60°F. and 1500°F. **Elastic modulus—**29,000,000 **Properties of No. 6 Cold Rolled Strip:** When cold rolled, annealed dead soft, and with a bright, smooth surface, this Stainless will show the following average properties: **Tensile strength** lbs. per sq. in. . . . . 75,000 **Rockwell hardness** . . . B-80 **Erichsen**—1" tools 8

note: *The physical properties of all grades of Stainless depend upon form, heat treatment or cold working. Wider ranges of properties are available in certain forms. Take up your specific problems with our Metallurgical Department.*

Carpenter STAINLESS STEELS

BRANCHES AT Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, New York, Philadelphia

IT'S vitally important for America's future airmen to get off to a right start . . . with a good ship that answers to a finger's touch, a reliable engine and a prop that can take it. That's a hard-to-beat combination—especially when it's the Fairchild-Ranger-Sensenich combination as it is in the PT-19.

On the nose of the PT-19, or the PT-22, PT-23, PT-26, N2S-3 or wherever you find a Sensenich Propeller, you can be sure it's *right.* For Sensenich, world's largest manufacturer of wood propellers, knows how to make them right!

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SENSENICH BROTHERS AIRCRAFT PROPELLERS, Adjacent to Lancaster Municipal Airport, Lititz, Penna.—West Coast Branch, Glendale, Calif.

(*Continued from page* 160)

and low viscosity nitrocellulose should be explained, because variations in the viscosity of this material produce entirely different physical properties.

In this connection, a simple experiment will be definitive. Equipment used in determining viscosity is shown in fig. 1. A weighed amount of nitrocellulose is dissolved in a solvent and placed in a glass tube. If a steel ball of a standard weight, dropped in this solution, takes ½ sec to fall 12 in, half-second nitrocellulose is indicated as having been used in the preparation of the solution. On the other hand, if the time consumed is 150 sec, nitrocellulose of 150-sec viscosity was used. While the total solids content of each solution will have been equal, one will have been much thicker than the other. The difference is due to the fibre construction of the nitrocellulose. The longer the length, the higher the viscosity—and the better the tautening properties and durability of the finish. Fibre construction of nitrocellulose of 60-80 sec is shown in fig. 2.

Applying Finish to Fabric

With this understanding of the necessity for relatively high viscosity nitrocellulose in the formulation of a dope, and of the difference between high and low viscosity nitrocellulose, let us follow the application of the finish to the fabric. Two coats of clear dope should be applied so that there is a sufficient foundation to allow a good bond between fabric and tape. Usually, after the first two coats of clear, it is necessary to apply four spray coats to fill in the voids between the warp and fill threads. This not only produces a smooth surface, but likewise one that gives strength and rigidity to the fabric.

If insufficient adhesion between the tape and fabric is encountered, an additional coat of clear should be applied on the fabric where the tape is to be laid. The tape should always be rubbed well while wet, so as to remove all blisters and air pockets before the application of subsequent coats of dope. Freshly pre-coated tape gives better adhesion to fabric than regular tape. It is of utmost importance that surfaces to which tape is to be applied are free from blush, since this is one of the most common causes for poor adhesion.

After the dope surface has dried it is ready for the pigmented top coats of lacquer. Whether glossy or non-reflective, they have better flexibility and less tautening properties—due to a higher percentage of plasticizer used in their formulation—than the undercoats of clear, and should always be applied so as to give complete opacity. This property is sometimes secured by the addition of aluminum powder to the last coat of clear dope. No more than 4 oz should be added, since an excessive amount usually results in poor adhesion of the top coats to the undercoats. It is important that complete opacity of the top portion of the film be obtained, since ultraviolet rays have a destructive effect upon clear nitrocellulose. A good quality clear nitrate dope becomes brittle when exposed for a short time to direct sunlight.

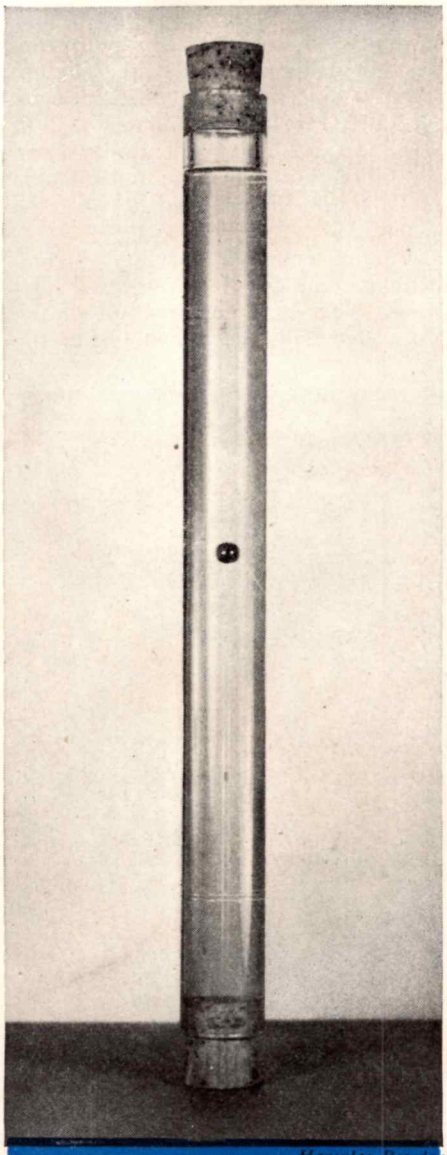


Fig. 1: Falling ball apparatus used in determining viscosity

Reducing Viscosity by Heating

The application of dope by heating is a method which provides more solid material per coating operation. Rather than reduce the dope to spraying viscosity by the addition of thinner, the viscosity is reduced by heat, and thus a larger percentage of solid material is applied. The regular specification dope, as described in specification AN-TT-D-514, contains approximately 10% solids and is reduced, for spray application, by one part of thinner to three parts of dope, which reduces the solids to less than 8%.

Hot dopes may be formulated with a solid content considerably higher than 10% and requiring no reduction. Consequently higher solids may be applied to the surface of the fabric. The

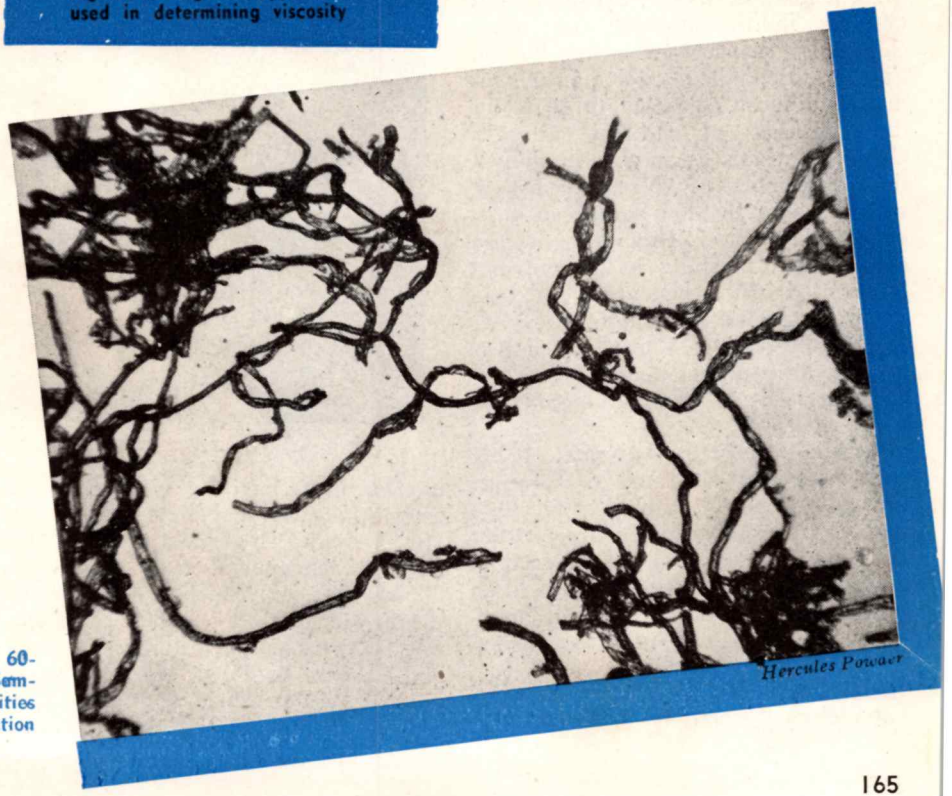


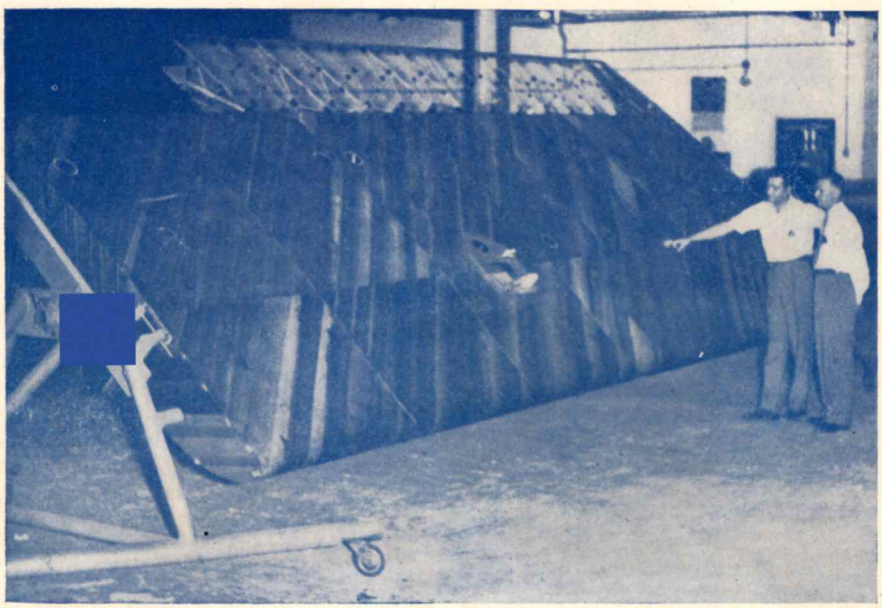
Fig. 2: Photomicrograph of 60-80 seconds nitrocellulose. Samples having lower viscosities show shorter fibre construction

use of slow-evaporating solvents must be utilized in the formulation of hot dopes, so as to allow the higher solids deposited on the fabric to flow out smoothly. These solvents render the film free from blushing and pin-holing troubles. The formulations, applications, and durability properties of hot finishes have not yet fully emerged from the experimental stages.*

It is in order now to discuss the comparative merits of aircraft finishes formulated with cellulose acetate, cellulose acetate butyrate and nitrocellulose. Generally speaking, the first two materials have better resistance to weak acids and alkalis, hydraulic and de-icing fluids, gasoline and other chemicals than does nitrocellulose. Furthermore, they are non-inflammable, a most desirable property in the finishing of military aircraft. Cellulose acetate is soluble in only a limited number of solvents, most of which are of the low-boiling or fast-evaporating types. These solvents are conducive to blushing, so that finishes formulated with them tend to give inferior service in humid weather. Due to the poor solubility of cellulose acetate, finishes formulated with it are characterized by poor adhesion between coats.

Cellulose acetate butyrate, being soluble in a wider range of solvents, produces finishes with less blushing and better adhesion characteristics than may be formulated with cellulose acetate. Nitrocellulose is soluble in an unlimited number of low-and high-boiling solvents, permitting the formulation of finishes which give less blushing and embody better adhesion properties than are obtained with cellulose acetate or with cellulose acetate butyrate. Finishes formulated with it have extraordinary flexibility and durability, but are more inflammable than those formulated with the acetates.

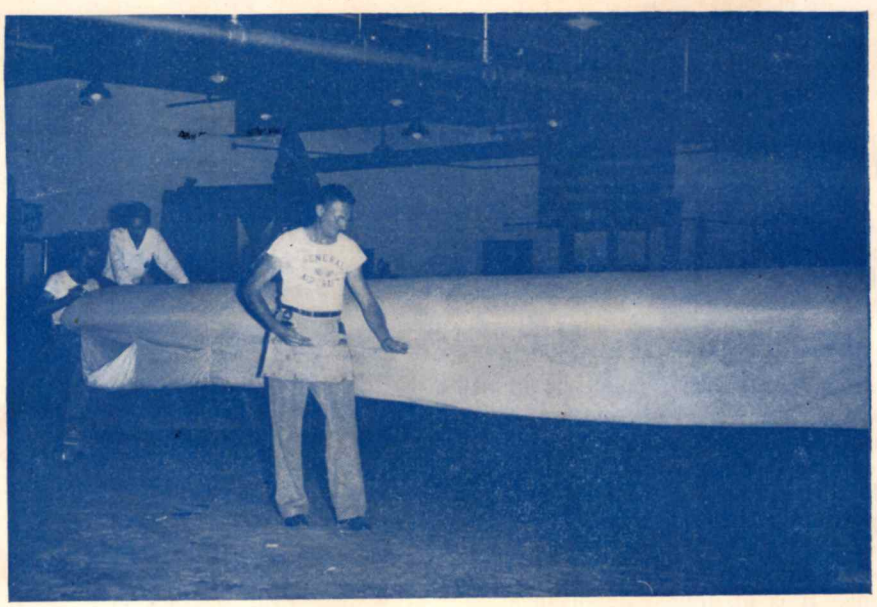
Another system deserving of comment is that for fabric-covered plywood. This is a combination of the two systems just described. After the interior parts have been finished, the exterior is given a single coat of sealer (fig. 3) and a single coat of dope. The cloth is then applied in the form of a blanket (fig. 4), which is cemented to the first coat of dope by the application of two parts of retarding thinner and one part of dope. This mixture is applied to the fabric and rubbed in well so that all bubbles and blisters, which may result in pin-holing, are removed. The actual operations are shown in fig. 5. After this cementing coat has dried, it is necessary to cut the fabric wherever there is an overlapping of wood joints, or wherever controls are brought out through the wing. This operation is shown in fig. 6. The loose ends of the fabric are cemented down before the application of tape, after which it is sanded and finished according to the same procedure as used in the finishing of fabric.



General Aircraft

Fig. 3, above: Wings ready for inspection after application of sealer

Fig. 4, below: Cloth being applied to a plywood wing



General Aircraft

Humid Atmosphere to Be Avoided

Discussion here of the reasons and remedies for some of the common troubles encountered in the finishing of fabric may prove instructive. Blushing is a fault commonly encountered, and is caused by the application of finishing materials in humid atmosphere. It is the result of the rapid evaporation of the volatile portion of the finish, causing a chilling of the atmosphere impinging upon the finish itself, which in turn causes condensation of moisture upon the wet film. This moisture actually becomes part of the solvent, and, since it is incompatible, precipitates the nitrocellulose in the film. This condition is clearly shown in fig. 7.

When the condition is bad the best correction is the application of retarder over the blush surface. By the addition of retarder the evaporation of the solvent is slowed so that the dew point is not reached and no moisture is acquired by the film. The

(*Continued on page* 171)

*Mr. Oudhoff, one of the co-authors of the present article, is preparing a paper on the subject of hot finishes, to be published in AERO DIGEST at some later date.—ED.

HOW A NEW TYPE AIRPLANE TUBE SOLVED A BRAKE-HEAT PROBLEM

This is a cross section of the "U.S." Fabric Base Tube that solved the heat problem caused by excessive braking on the Cessna Bobcat Advanced Bomber Pilot Trainer. A reinforcing cord insert extending across the vital bead area increased 100 times the service life of the tube.

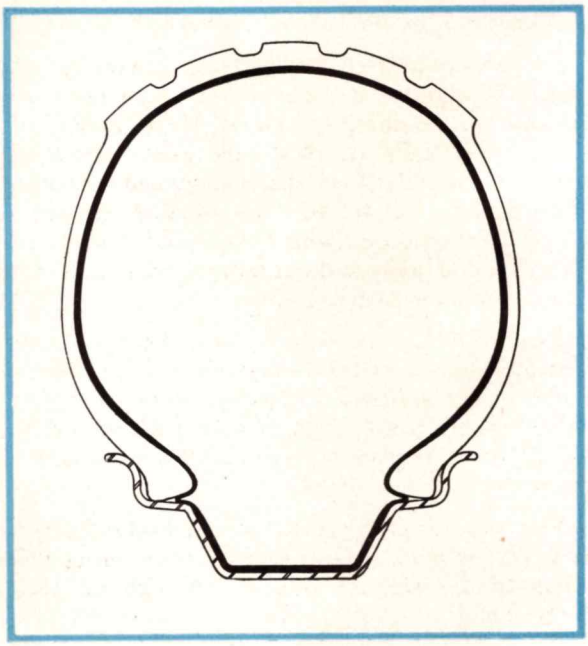
UNITED STATES RUBBER COMPANY

THE CESSNA BOBCAT BOMBER PILOT TRAINER

Cadets of the United States Army Air Forces fly this twin-engined advanced trainer before they take the controls of the Army's giant bombers. Like its namesake, the Cessna Bobcat is light and fast, giving the cadet his first thrill of fighting power in the air. But with this thrill, this feeling of speed, it was only natural for student pilots to use brakes excessively... and this caused overheating which made tubes fail, sometimes in less than five hours.

THIS WAS THE PROBLEM

It was natural for the cadet pilots at the controls of the Cessna Bobcat, coming in for landings at higher speeds than they had ever known before, to "tramp" on the brakes and keep them on continuously even while taxiing the plane. Temperatures as high as 750° Fahrenheit built up in no time... heats so high that no rubber tube, however good or however reinforced, could stand the gaff. Working with the brake manufacturer, Cessna engineers brought the temperature down to around 450 degrees. Performance improved, but still tube failures occurred far too frequently. That was the problem... an immediate answer had to be found.



●

When an airplane tire rolls over the ground at high speeds, with as much as 35% deflection, the beads rock back and forth on the rim, stretching out the tube just above the toe of the bead. When the tube is cool, it remains elastic and snaps back into place without damage. But at high temperatures, the tube thins out, is stretched farther and farther and finally some of the weakened, thinned-out rubber is tucked in between the bead and the rim. The result is a "pinch"... and quick tube failure.

Listen to the New York Philharmonic Symphony broadcast over Columbia network every Sunday afternoon 3:00 to 4:30 P. M. Eastern War Time.

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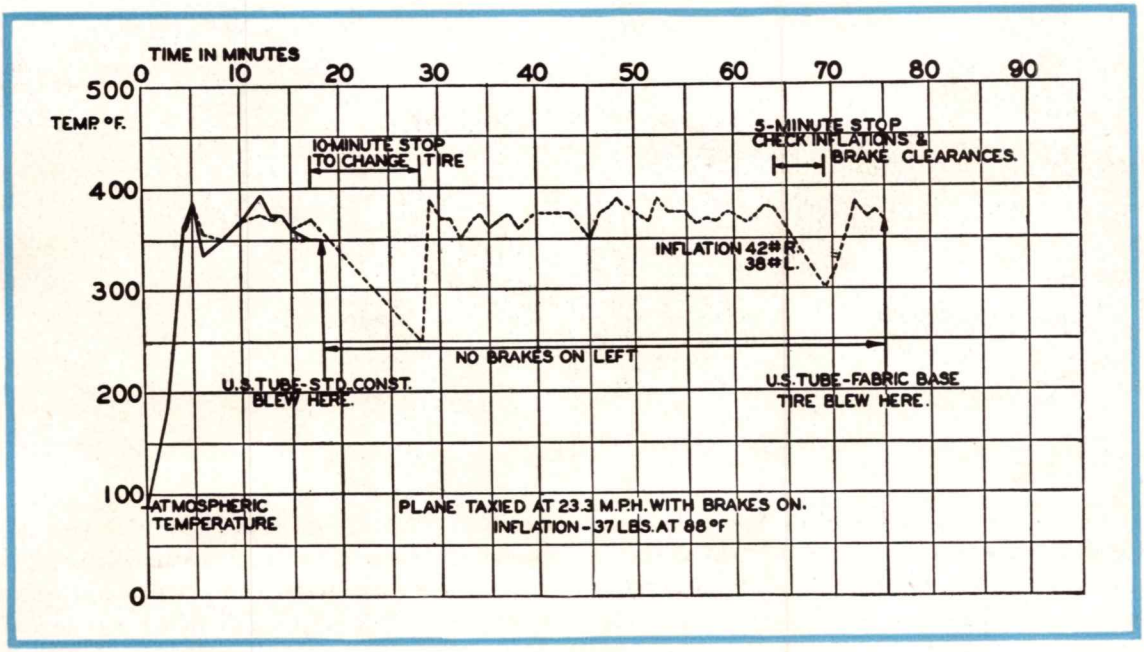
US
TRADE MARK

THIS IS THE ANSWER WORKED OUT BY CESSNA AND "U. S." FIELD AIRPLANE TIRE ENGINEERS



Jim Berry, one of the "U.S." Field Airplane Tire Engineers working with Cessna on the problem had a trick up his sleeve. Taking a leaf from his experience on bus lines where high brake-drum heats are frequently encountered, he suggested to Cessna that the "U.S." Fabric Base Tube might be the answer to this problem just as it had been the answer in the case of certain city-type buses.

Special tubes of this type were built and tested under the most severe conditions. In the test shown in this chart, a U. S. Royal Rayon Airplane Tire with a conventional construction U. S. Royal Tube was mounted on the left landing wheel of the Bobcat. On the right wheel a U. S. Royal Airplane Tire and Fabric Base Tube were mounted.

In five minutes of taxiing with brakes on, the temperature, checked by a pyrometer, was over 450°... and in 18 minutes the conventional tube blew out. They took ten minutes out to change the tire. Then, on with the test. The tire equipped with Fabric Base tube went on and on for 75 minutes with brakes applied until the casing failed because of carcass fatigue. The problem was solved—the proof of the pudding is that U. S. Royal Tires equipped with Fabric Base Tubes have been in service for 450 to 500 hours without failure...when before, tubes often failed in less than five hours.

Read what Cessna engineers said about the test: "It is concluded from this test that the Fabric Base Tube will outlast any casing under these conditions." If you are faced with a tube problem, the "U.S." Fabric Base Tube may be your answer. The services of a "U.S." Field Airplane Tire Engineer are available to test it on your aircraft.

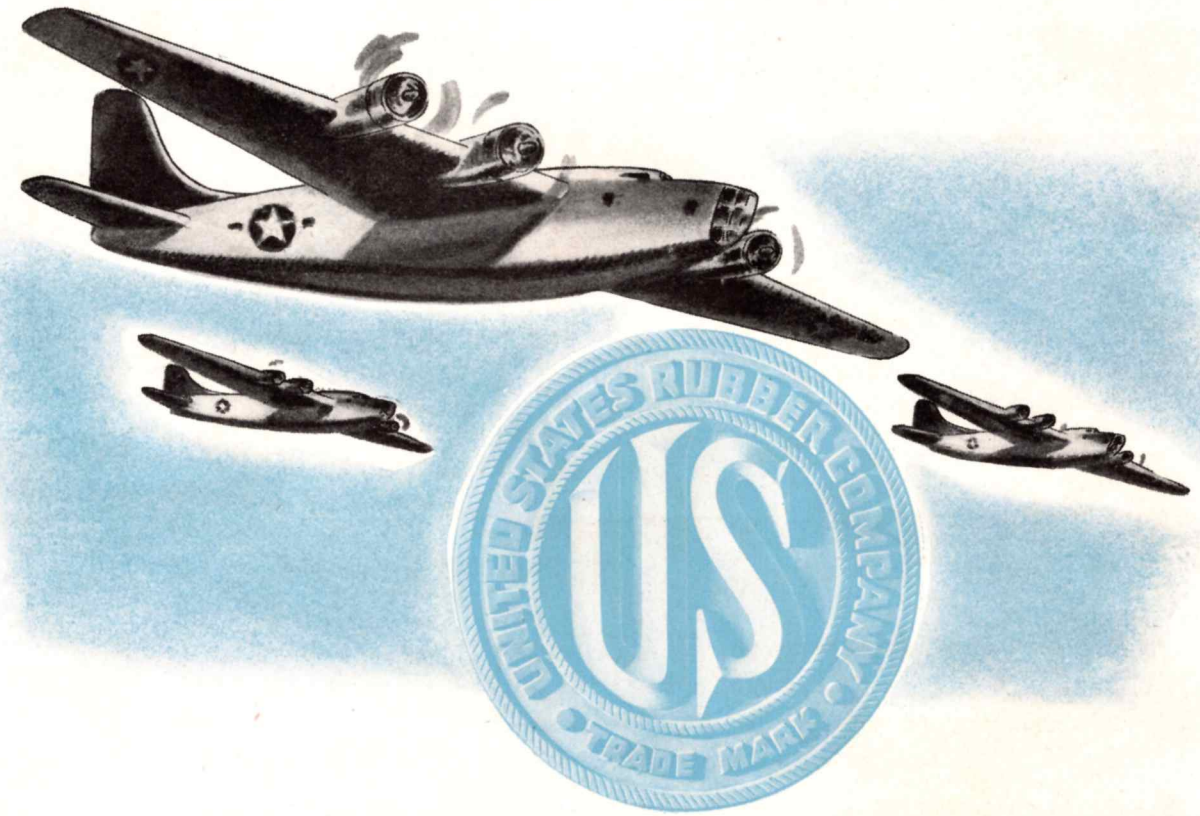
The way this problem was met and solved is not an isolated case. It is an example of the practical engineering service that "U.S." offers to the aircraft industry through its Field Airplane Tire Engineers.

J. G. Berry, "U.S." Field Airplane Tire Engineer, and A. E. Kangas, Cessna's Service Manager, inspect an installation of U. S. Royal Airplane Tires and Fabric Base Tubes. New Cessna Bobcats are now 100% "U.S." equipped on main landing gear.

UNITED STATES RUBBER COMPANY

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.

How "U. S." Field Airplane Tire Engineers Can Help You With Your Tire Problems



"U.S." Field Airplane Tire Engineers are located at or near the principal aircraft manufacturing centers. Each of them is a graduate engineer. Each has had a generous background of high speed, heavy service tire and tube operation and now applies all of this training specifically to airplane tire and tube problems. Through this service, coordinated and assisted by a staff of technicians at the factory, such achievements as the rayon carcass airplane tire, Conductive Rubber, the Ice Grip tire, the Fabric Base Tube have all been developed. Each product advance has answered a specific problem in airplane tire engineering. As new problems are met, these "U.S." men are ready to help you find their solution.

This new book of Airplane Tire Facts is yours for the asking!

Just off the press, this 62-page book contains the latest technical data and engineering information on landing wheel, tail wheel and beaching gear tires and tubes. A series of 33 Load-Deflection Curves shows at a glance percentage deflection and deflection in inches at varying loads and pressures. A request on your firm letterhead will bring your copy without charge.

UNITED STATES RUBBER COMPANY

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(*Continued from page* 166)

spraying of retarder over the blush surface actually re-dissolves the precipitated nitrocellulose, as shown in fig. 8. It is important that a blush should always be removed from a film before the application of subsequent coats. Before proceeding, subsequent coats should be reduced with a sufficient amount of retarder, as part of the thinner, to avoid further blushing.

Wherever possible all fabric surfaces should be finished in a humidity-controlled and air-conditioned spray room, with temperature at around 68° F, and a relative humidity of 50%. If this is not practical, however, it is suggested that temperature and relative humidity readings be taken at regular intervals and compared with records pertaining to the reduction of finishing materials. From these records may be determined what amount of thinner and retarder will have to be added to any finish so as to prevent blushing under any given atmospheric conditions.

Prevention of Pin-holing

Another common trouble encountered in the application of dope is pin-holing. It is caused by the evaporation of some of the solvents and their being trapped between the fabric and the wood or metal, as the case may be. When the fabric shrinks over these trapped solvents, a pressure is created which forces the solvent into the dried film in the form of a bubble. This is released again during the application of the next coat of dope. In this way the bubble finally works its way through and into the final coat, resulting in pin-holes as shown in fig. 9.

Such a condition should always be corrected in the first coat. Retarding thinner may be brushed over the surface where pin-holing is most prevalent, followed by a thorough rubbing of the fabric. This not only releases the bubble from the foundation coat, but also gives a better bond of the fabric to the wood or metal over which it is applied.

In considering the application of organic coatings to metals, the prime factor of importance is that of adhesion. Without proper bond of coating materials to metal surfaces, all other qualities of the coatings are lost. Since proper adhesion is directly affected by proper application and by the attainment of a proper condition of the surfaces to be coated, a few fundamental facts about adhesion are here set down for the benefit of the manufacturer, toward his better understanding of the reasons for the recommended methods of coating application and metal cleaning.

That coating materials will adhere best to a rough surface is self-evident. The many angular irregularities of such a surface permit the film to wedge itself into cavities or to hook itself under any angular projections. Among paint men this is generally described as providing a "tooth" for the film. The surface texture of most all hot- or cold-rolled sheet steel is rough enough to provide ample tooth for practically all types of organic coatings. The only precaution necessary is to remove all oil or foreign matter from the steel and to flow a wet coat on the surface, so that the wet film will run into and fill all of the cavities and irregularities. Irregularities in steel surfaces are microscopic and, of course, not apparent to the touch.

The types of metal that do not provide a good tooth, such as lead, zinc, aluminum, magnesium, cadmium and others, regularly produce their own oxide films. They oxidize rapidly and the oxide coating fills in all the cavities and irregularities. Because they are soft metals, their surfaces become smooth when they are rolled or worked into sheets or shapes. Such surfaces do not provide a good tooth for the

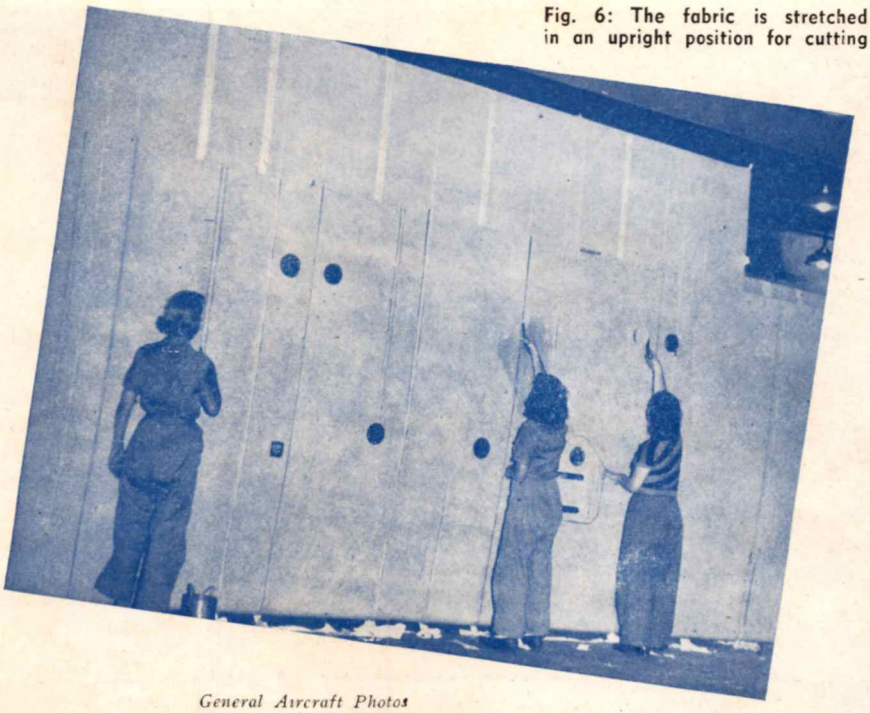

Fig. 6: The fabric is stretched in an upright position for cutting

General Aircraft Photos

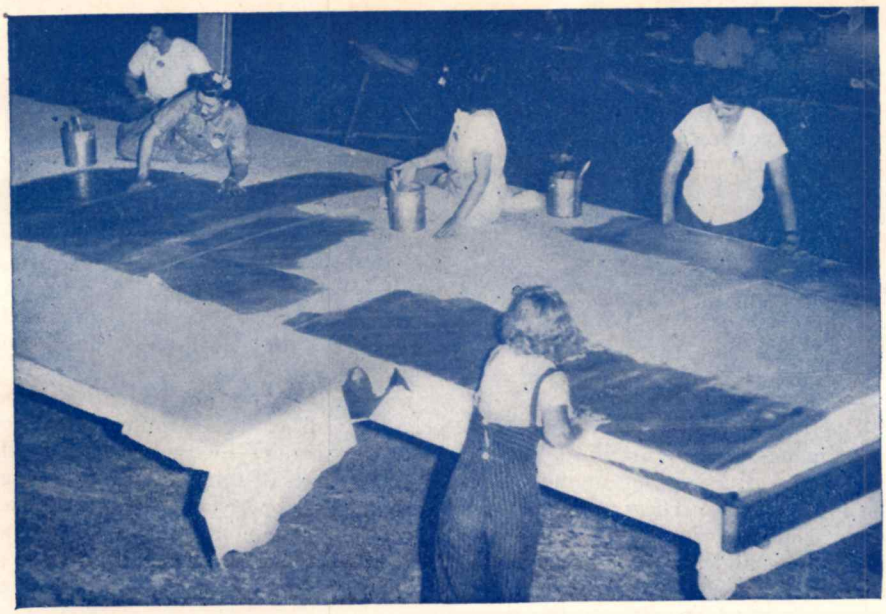

Fig. 5: Use of pressure during spreading of a dope-and-thinner mixture over the cloth, promotes adhesion of fabric to wood and releases bubbles which might cause pin-holing

paint film. In some cases, as with lead, the oxide film has poor adhesion to its own metal, hence any coating applied on top of the lead oxide film will develop no adhesion to the metal. It is impossible to remove all of the oxide film, for no sooner is the oxide coating removed than a new one is immediately formed. Unless the oxide coating has good adhesion to its own metal, it is impractical to apply organic coatings to the softer metals.

Fortunately these metals that are difficult to finish do not need an organic coating for protection, since they form their own protective oxide coating. But often it is desirable to change their appearance, as in the case of aluminum and magnesium when used for wartime aircraft which must be camouflaged. The oxide coatings of aluminum and magnesium, or their alloys, do develop good adhesion to their own metals, and consequently it is possible to apply organic coatings to the oxide films.

Most of the common lacquers or paints develop poor adhesion to the oxide coatings of aluminum or magnesium, except when the oxide is applied artificially as in the anodic process. The difference between the natural and artificial oxide coatings is a difference in density. The artificial anodic coat, having been formed by the rapid chemical oxidation of the aluminum surface, develops an oxide film with considerable depth and with much porosity. The natural oxide having been formed by slow oxidation in air provides a non-porous film with only slight depth. The more porous surface offers the better opportunity for adhesion. An anodized surface, however, remains porous for only a relatively short time. Natural oxidation continues to take place, and soon all of the irregularities in the porous surface are filled in, leaving a porcelain-like surface similar to the natural oxide film. It is most important to apply the finishing material immediately after anodizing in order to obtain the greatest adhesion.

In aircraft work it is important to anodize and prime all parts and assemblies in one continuous operation. The prime coat should under no circumstances be removed, since the anodized film turns to a porcelain-like surface, even underneath the prime coat. The hardening action of the anodic film does not detract from the adhesion of the primer; in fact, it may improve the adhesion, but by removing the primer the original adhesion is lost, that was gained when the anodic film was porous.

Fig. 7, above: Enlarged 125 times, photo shows unsatisfactory surface film. Note white precipitation of nitrocellulose

General Motors Photos

Fig. 8, below: Same film as in fig. 7, after application of retarder causing nitrocellulose to redissolve. Black spots are foreign matter

Protective-Oxide-Forming Metals

The two types of protective-oxide-forming metals thus far discussed are fairly indicative of the conduct of all the softer metals. They either produce oxide coatings with poor adhesion to their metals and are impractical to finish with organic coatings, or they produce an oxide having good adhesion, upon which certain types of organic coatings can be applied successfully. A variety of types of primers, enamels, lacquers, etc., are available for use with the different metals.

The importance of aluminum in the aircraft field makes particularly appropriate a discussion of the finishing materials used on it. The materials that work successfully on aluminum do equally well on magnesium. The primer used for these metals is zinc chromate primer, fully described in Navy specification P-27B-2, and Army specification 14080. The difference between the Army and the Navy specifications is slight, but worthy of note, since the Navy primer must withstand severe salt water corrosion effect, which accounts for the omission of rosin or rosin derivatives. There is little doubt but that even small amounts of rosin or its derivatives will detract from the corrosion resistance of the primer. Recently it has been agreed that one product could practically meet the requirements of both Army and Navy work, and consequently the new combined specification AT-TT-P-656A has been published.

Zinc chromate primer may be applied by spray or dip, after reducing one part primer by two and one-half or three parts of thinner. The spraying primer may be reduced slightly more than the dip primer, but a balance can be maintained to meet the requirements of both. The importance of mixing the

primer when the reductions are made cannot be over-stressed, because therein lies the difference between the application of a uniformly thin coat, and the application of a flocculated granular or lumpy one. The reducer should always be added to the primer in small quantities with constant agitation. Subsequent additions of reducer should not be added until the preceding quantity has been completely dispersed.

Zinc Chromate Primer Unstable

The aircraft manufacturer must keep in mind that zinc chromate primer is a peculiar combination of not altogether compatible ingredients, and that with the added strain on such a combination of approximately one part to two and one-half parts reduction, an exceedingly unstable mixture is produced. It must be kept under constant agitation from the time it is reduced until it has been used. Manufacturers having plants equipped with large mixing tanks connected to spray booths by means of pipe lines will find it necessary to disconnect these lines every six to eight months for a thorough cleaning. On original installation, or in reinstalling cleaned lines, it is economical to use unions at each pipe connection so that small sections can be cleaned separately.

The spraying of the primer is simple. Because of its very low viscosity, it sprays out of the gun easily and flows on the work with a quick-wetting coat. Its pigment has poor covering qualities and it has a definite yellow green color which serves as a visual guide for maintaining uniform film thickness. The dipping of primer presents more of a problem. The fact that it does not cover well decreases the possibility of obtaining a uniform coat, because each run caused by an obstruction in the dipped part will overlay an additional coat, which is revealed by the deeper color.

When the part or assembly is to be used on the interior—such as structural interiors of wing sections—the runs are not objectionable, but when used for exterior surfaces they cause irregularities in the airfoil surfaces. To counteract runs on dipped parts, the addition of a small quantity of solvent having a slow evaporation rate, such as is described in specification AN-TT-T258, will help by allowing the runs to flow longer.

Primers cannot be continuously used in the dip tank for any great length of time. The constant airation or oxidation of the surface of the primer causes the pigment to become conglomerated, the larger pigment particles thus formed imparting a granular or streaky appearance to the dipped film. At the first sign of this condition, which is called "flocculation," the manufacturer should stop dipping and use the primer for spray work. The spray gun, if the pigment has not been allowed to coagulate too long, will break up the flocculated pigment particles. The capacity of the dip tank should not exceed the amount of primer that can be used in spraying.

Laister-Kauffman Co.

Final assembly of gliders. Craft in foreground is undergoing preflight inspection; others are being checked before covering

Murphy Varnish

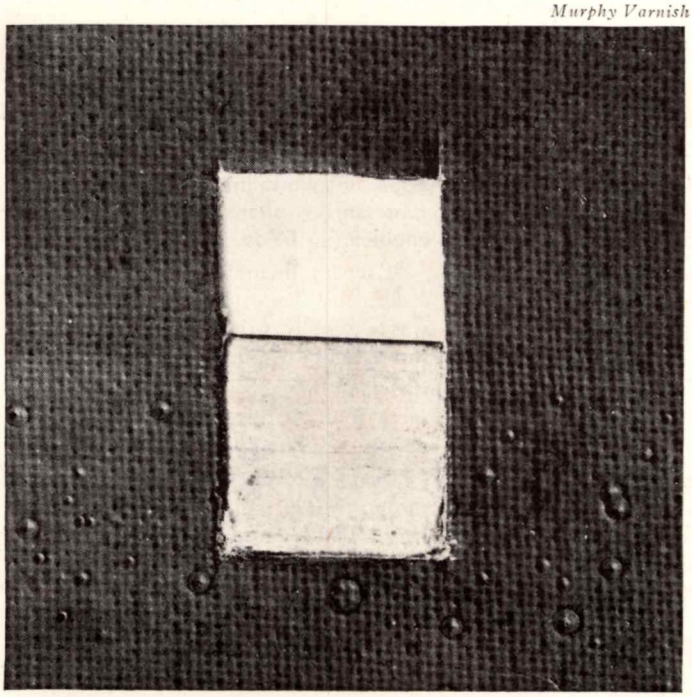

Fig. 9: Panel showing pin-holing condition in fabric that has been applied over a wood frame. Pin-holes appear in sections backed up by wood, through which solvents could not evaporate

Flocculation-Resistance Test

The aircraft manufacturer should test primers from different sources to determine their ability to resist flocculation. The Army and Navy specifications require only that flocculation shall not be excessive, but considerable difference does exist as between various primers. A simple test may be conducted to determine the difference. This test is not devised to show how good primer adhesion can be, but

(*Continued on page* 175)

BACK THE ATTACK—WITH WAR BONDS

Battleship of the Skies

You're looking through the waist gunner's window of a Boeing Flying Fortress*. . . at another Fortress on its test run near Seattle. Peaceful enough here, it nonetheless represents 32 tons of the most deadly fighting mechanism ever devised.

The Boeing Fortress now has a maximum bomb capacity of more than 10 *tons* . . . equaling or exceeding that of any other bomber, Allied or Axis, now in service.

Its stability and general flight characteristics make it a superior "platform" for high-level bombing of the most destructive accuracy.

The Flying Fortress has great defensive firepower and is credited with a remarkably high average of successfully completed combat missions.

All this, of course, is not just happenstance. It stems from the determination of the Boeing company nine years ago to build an airplane unlike any then in existence, an airplane that would be truly a "Battleship of the Skies."

To carry through such a project meant years of costly research. It meant continuing advancement from one stage to another, including long experimentation at stratosphere altitudes where few men had ever been. It meant utilizing the skills of many hundreds of engineers representing more than 25 different engineering fields.

It meant financial courage of a high order, for the original Flying Fortress was a wholly private venture financed throughout by Boeing.

Today Boeing's foresight and faith are more than justified by the outstanding record of Flying Fortresses in the war.

Tomorrow you may look to Boeing for peacetime products of equal leadership. The phrase "Built by Boeing" means they're bound to be good.

DESIGNERS OF THE FLYING FORTRESS • THE STRATOLINER • PAN AMERICAN CLIPPERS **BOEING**

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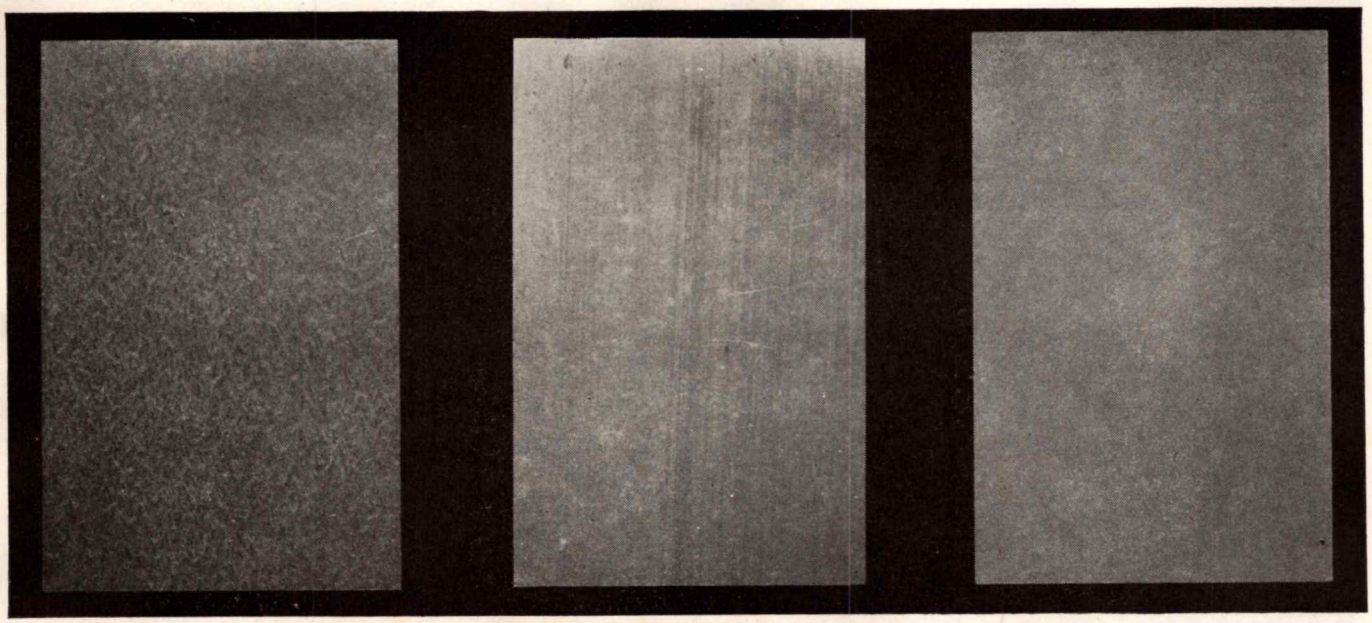


A B C

Fig. 10: Panel A shows a flocculated condition with film appearing broken and eroded; panel B shows a silked film, identified by the glossy, straight parallel lines; panel C shows a good film, smooth, with uniform gloss providing good adhesion to unanodized aluminum

(*Continued from page* 173)

rather how poor a bad primer can be and how in some cases an excellent primer can be only fairly good.

First, thirty parts of specification primer is reduced with ninety parts of thinner AN-T-A-B, and after a thorough mixing, 80-cc is poured into a stoppered 100-cc graduate. Next the primer is allowed to settle, and after 24 hours the graduate is shaken until the primer is completely dispersed. Finally, a small amount is poured on the upper portion of an inclined *unanodized* aluminum panel and allowed to run down and dry. An anodized panel would show little difference, while an unanodized panel will show a definite difference between good and bad primers.

The dried film should now be examined for the streaky appearance and the test repeated on succeeding days with each sample under test, until the flocculated film is definitely noticeable on them all. The primer which stands the greatest length of time without the appearance of flocculation—provided it meets all the other requirements of the specification—must be considered the best for dipped tank application.

The assumption that a poorly dispersed pigment, or one which has been allowed to coagulate, is the cause of flocculation, is fundamentally correct; but actually there are two different types of flocculation. One is caused by poorly dispersed, or coagulated pigment, the other is caused by a number of factors which are not completely understood. The latter type, by many paint chemists is called "silking." However, the two terms "flocculation" and "silking" are often used interchangeably. In order to discriminate between the two types, it should be borne in mind that flocculation is definitely detrimental to the film, while silking is not always objectionable.

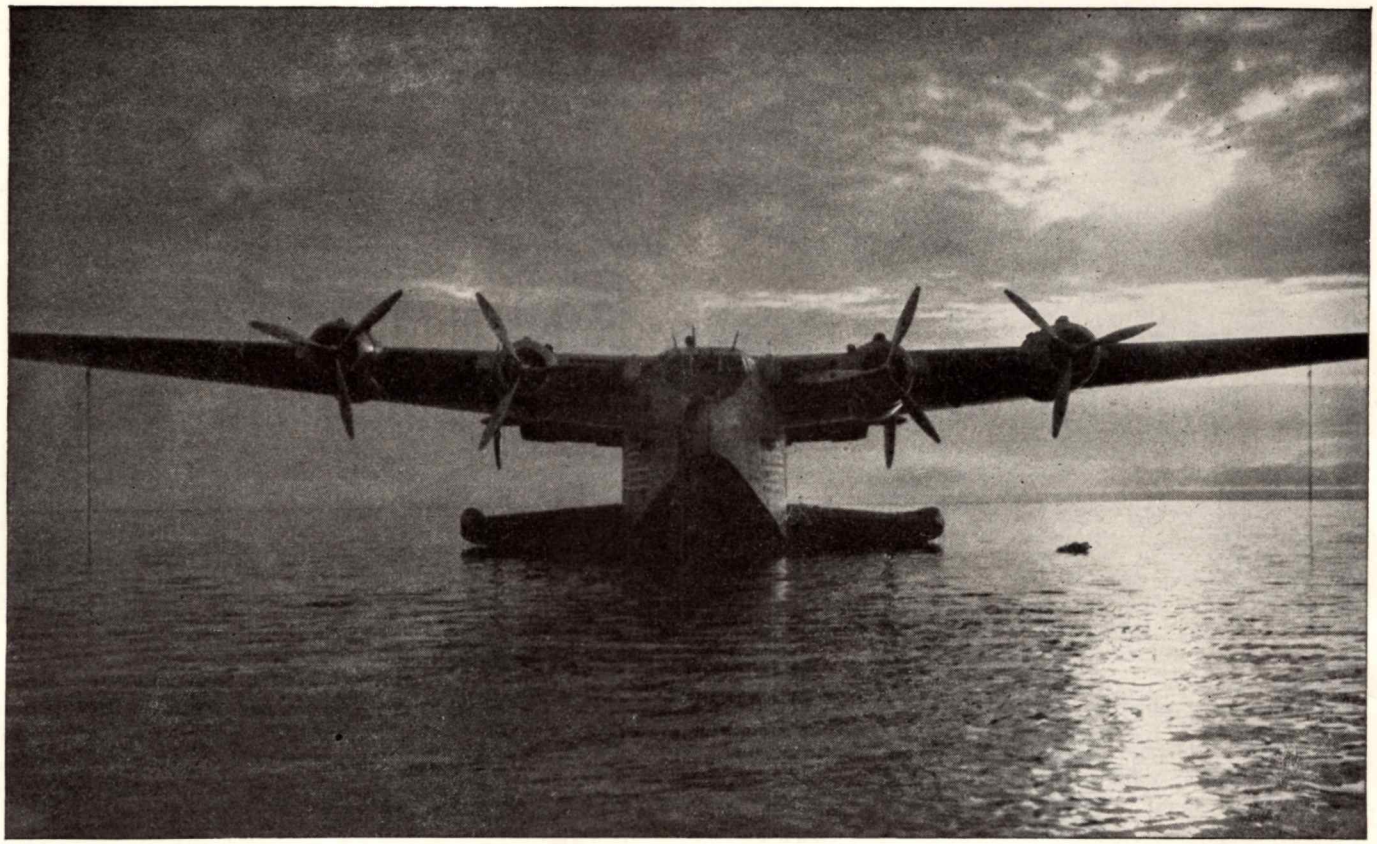
Comparison of Films

The panel shown in fig. 10A illustrates a flocculated condition. The film appears to be broken and eroded. Fig. 10B shows a silked film, recognized by the glossy, straight, parallel and flat lines. Fig. 10C shows a good film which is perfectly smooth, with gloss and color uniform over the whole panel. The smooth, uniform film on panel C will have fairly good adhesion

(*Continued on page* 249)

Piper Aircraft

Ferris wheel system used in spraying wings and fuselage. After one complete revolution the parts are sufficiently dry for the application of the succeeding coat



7,000,000 miles . . . 50,000 passengers!

● SINCE MAY, 1939, Pan American Clippers have flown the Atlantic more than 1400 times . . . carried more than 50,000 passengers . . . logged more than 7,000,000 air miles.

And this is only one division of Pan American's World Airways System! BUT . . . before these record-breaking flights could be made, the famous Flying Clipper Ships had to overcome most formidable obstacles, within themselves—*friction and wear* of moving parts.

For this notable mechanical triumph, we can thank one vital mechanism—*anti-friction bearings!* They reduce friction . . . keep metal cool . . . postpone wear . . . and maintain precise location of parts.

NEW DEPARTURE ball bearings, by the *tens of millions,* are used in planes, ships, tanks, trucks, jeeps—and in the *machines* which make them. In fact New Departure has a major responsibility in the whole ball bearing war production program.

3177

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BALL BEARINGS

Nothing Rolls Like a Ball

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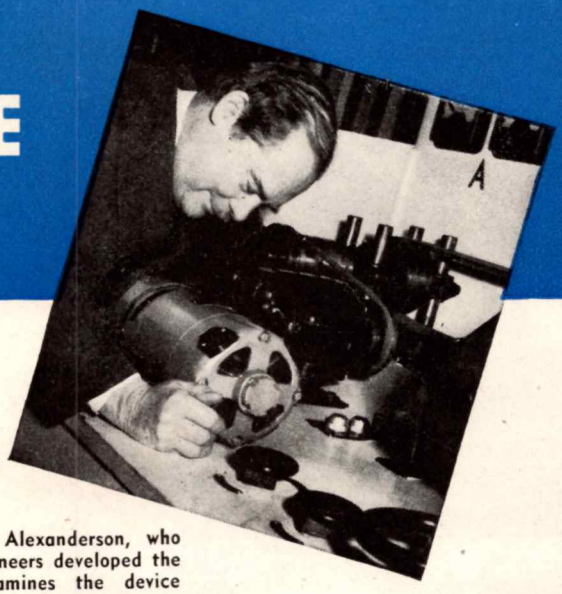
AVIATION USES OF THE AMPLIDYNE

R. A. AVERITT
Aviation Div., General Electric Co.



Dr. E. F. W. Alexanderson, who with other engineers developed the amplidyne, examines the device

● The amplidyne, developed by General Electric engineers shortly before the war broke out in Europe, has literally stepped up thousands of military and industrial applications, ranging from the mining of basic raw materials to manufacturing, maneuvering, and the firing of the weapons of war.

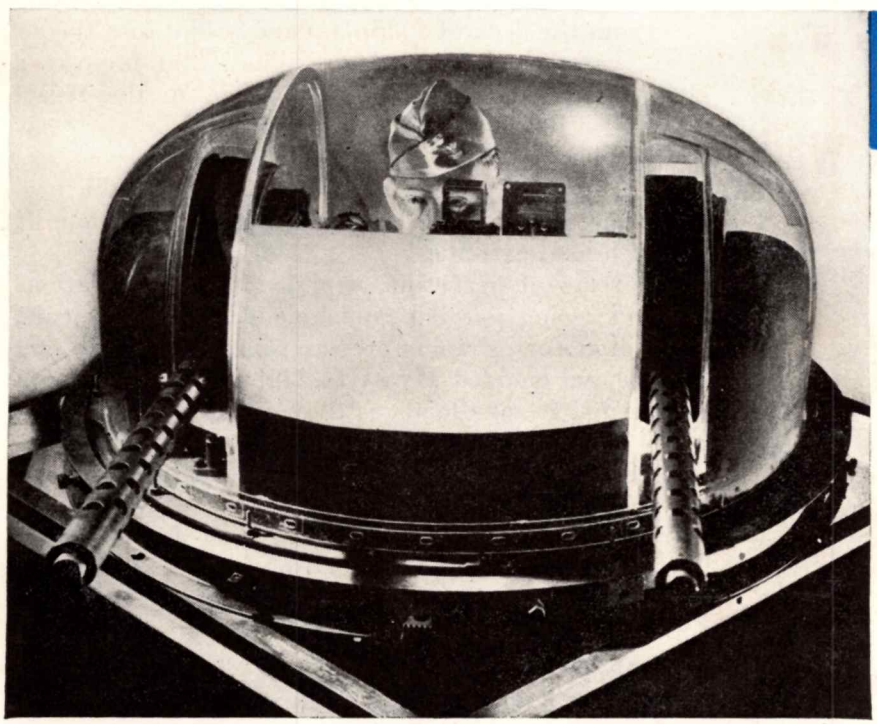
A typical amplidyne war assignment is the controlling of guns in aircraft turrets. Although one man could not by himself, without extreme difficulty, maneuver guns against the strong wind resistance encountered by a plane flying 400 miles an hour, with the amplidyne he controls fire power as easily in the air as he would a machine gun battery on land, and with the same ease as he would sight a rifle on a target range.

Wide Range of Applications

Already the amplidyne is in operation on fire control equipment aboard ships, on anti-aircraft guns and on searchlights both ashore and at sea. The device provides accurate control and quick response over a wide range, and because of its simple construction is not particularly vulnerable to bomb impact and flying splinters from shells. Simplicity of operation also is an important factor in installations aboard planes flying at high altitudes, where atmospheric conditions frequently impair the operation of certain types of equipment.

In these and in many other applications, the amplidyne—a natural partner of electronic devices—is proving its versatility by performing a wide variety of functions, as follows: (1) It controls speed accurately over a wide range. (2) It limits loads to protect electrical and mechanical equipment. (3) It controls torque and tension to improve product uniformity in winding, drawing and other similar operations. (4) It speeds up acceleration and deceleration to increase production of high-inertia machines. (5) It positions machine-tools and arc-furnace electrodes, simply and precisely. (6) It regulates current, voltage and power.

The amplidyne is an externally driven generator, outwardly similar to a conventional motor or generator. But its ingenious and unique use of a short-circuit and compensating winding creates such precise electrical balance that a signal as weak as half a watt will instantly release power capable of controlling the most powerful electrical machine.



Amplidyne-controlled aircraft turret guns are maneuvered with ease despite the strongest winds, permitting the gunner to concentrate on lining up the target

In explanation of the principle embodied in the amplidyne, a conventional two-pole 10-kw d-c generator, driven at constant speed, is illustrated schematically in fig. 1. For simplification, the armature is shown serving also a commutator and a single exciting field coil appears on the north pole. The small circles with dots and those with arrow tails represent conductors carrying current in opposite directions, perpendicular to the plane of the drawing.

Approximately 100 w of excitation power supplied to the field coil creates the excitation flux. This flux produces a full-load voltage of 100 v, which

(*Continued on page* 179)

SLINGSHOT...

with a 1,000,000 pound wallop!

From the deck of a ship a plane is shot into the air ...catapulted by a giant "sling" that imposes a load of about one million pounds on the Hyatt Roller Bearings in its mechanism.

What a wallop!

And what a bearing...that possesses the necessary design, precision and toughness to handle such load extremes!

Years of peacetime experience, in applications undergoing parallel punishment...like ingot cars, mill motors, shaping presses, railroad journals, etc. ...have enabled Hyatt to "inbuild" the stamina needed to take loads as they come.

In the battle of production...as on the battlefield...Hyatt Roller Bearings are fighting to win this war.

Fighting against friction...and for America!

Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

HYATT ROLLER BEARINGS

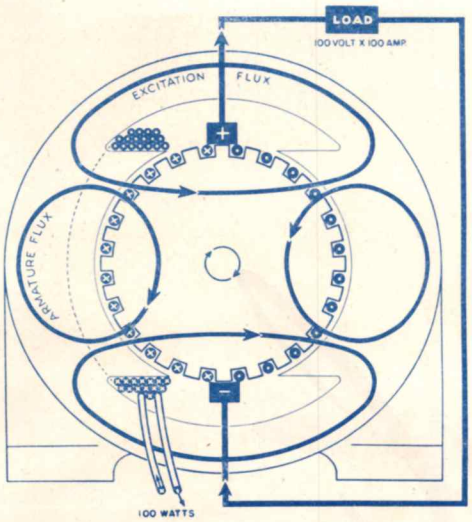


Figure 1

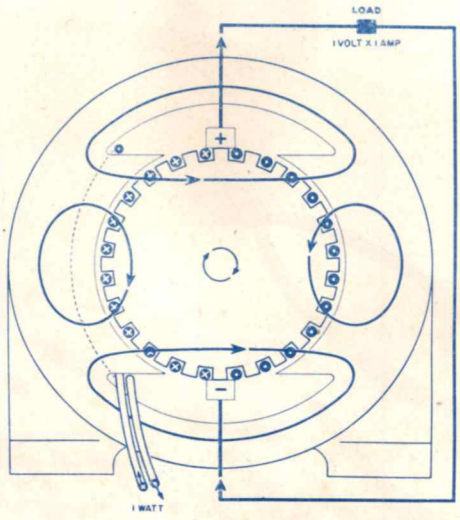


Figure 2

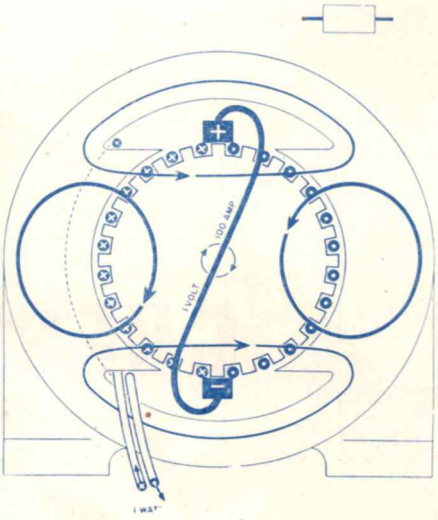


Figure 3

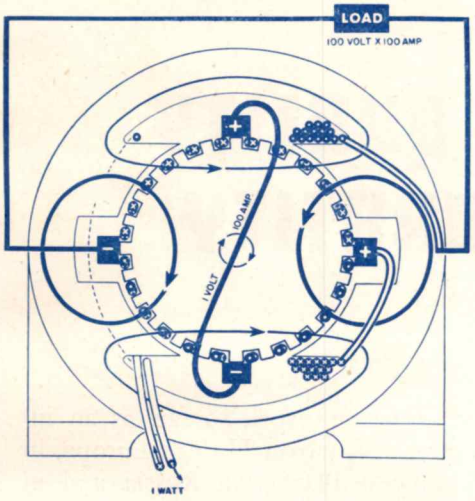


Figure 4

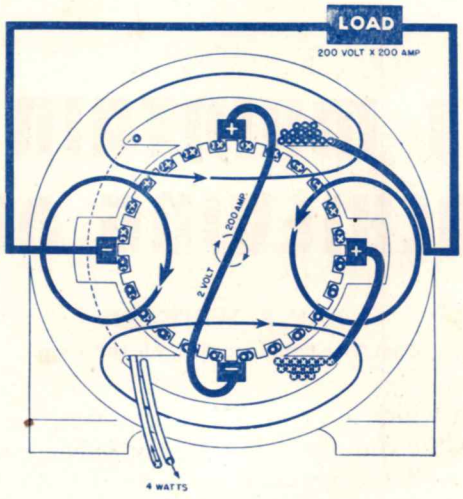


Figure 5

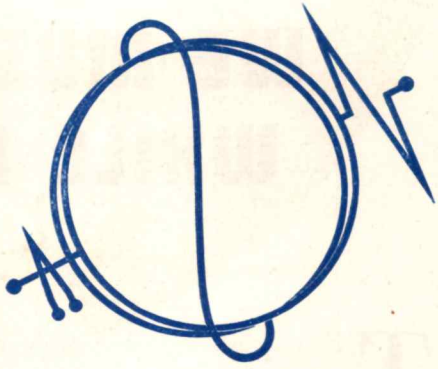


Figure 6

(*Continued from page* 177)

circulates 100 amp full-load current through the load, taken as a resistance of 1 ohm.

The load current, in flowing through the rotating armature conductors, creates a stationary armature flux, since the armature conductors on the left of the brush axis always carry current in the same direction and the armature conductors on the right of it constantly carry current in the opposite direction. The combined effect is the same as that of a stationary solenoid, producing flux as shown in the left and right flux loops. This armature flux is of about the same magnitude as the excitation flux but does not do any useful work.

Two questions arise: Can this idle armature flux be utilized? Can the excitation power, now too large for accurate control devices, be reduced to a point where small, quick-response mechanisms can be used, and yet release the same full output?

With a smaller field coil, and with excitation power reduced from 100 w to 1 w, the same conventional generator appears as in fig. 2. The newly reduced excitation power creates only 1% of the original excitation flux. Voltage at the brushes is reduced from 100 v to 1 v, and the load current, also reduced from 100 amp to 1 amp, produces only 1% of the former armature flux.

Thus, one objective has been attained —excitation power has been reduced to a value where it can be readily supplied and handled by precise control devices.

Restoration of Full-Load Working Flux

How can the full-load working flux be restored and yet retain this low excitation power? A short circuit across the brushes, as in fig. 3, restores the armature current and, consequently, the armature flux to their full original values. This is because of the internal resistance of the armature flux.

But the armature flux is still idle. Can it be harnessed and made to put the armature back to work delivering full kilowatt output?

To put the short circuit to work, two new brushes are added (fig. 4), one in the center of each armature flux loop, just as the conventional brushes are located in the center of the excitation flux. For clarification, it is assumed that these new brushes are not connected to any load and that the voltage between them is being measured. It was assumed in fig. 1 that the armature flux was of about the same magnitude as the full excitation flux in the same figure.

The armature flux being full value, produces full voltage, 100 v, between the new brushes. These new brushes are now connected to the same load, one brush directly, and the other through a compensating field shown on the south pole. Then, 100 amp, the full current, circulates through the load. In the same armature conductors the new load current adds to and subtracts from the short-circuit current. This is shown by the four different combinations of "dots" and "tails" seen on the armature conductors.

(*Continued on page* 250)

GUEST Editorial

WE MUST MAINTAIN QUALITY WHILE ACHIEVING QUANTITY

RAY P. WHITMAN
First Vice-President, Bell Aircraft Corp.

THE biggest, toughest problem which America's aircraft industry faces today is the continued attainment of topgrade quality, while maintaining ever-increasing production schedules. Quality of fabrication and assembly is a prerequisite if we expect to secure quality of operational performance.

Less than two years ago, our aircraft industry was in the midst of a gigantic tooling program. Huge factories were being built to turn out combat aircraft in numbers which even today seem fabulous. Hundreds of thousands of new workers were being hired; most of whom had never touched an airplane, let alone helped to build one. And it was not until after Pearl Harbor that most aircraft companies began, hesitantly and experimentally at first, to employ women for production tasks.

As an industry, we were still thinking in terms of building hundreds—if not scores—of aircraft, instead of constructing thousands.

During the past two years, we've done a job that all of us would have thought impossible except that we knew it *had* to be done.

If we failed to build the precise number of trainers and fighters, transports and bombers according to schedule, at least we came close enough to the vast quantities demanded so that our pilots, and those of the other United Nations, had the necessary equipment to tackle the job ahead.

How well we've done our work so far, as an industry, is being written today over Hitler's Europe, in the South and Southwest Pacific, in Russia and in China—wherever the forces of evil still persist.

But a job well done, to date, isn't enough. We all know that too many "sure thing" games have been lost in the last quarter or after two men were out in the ninth inning. The aircraft which will be flown away from our airports today and every day until final victory is won have got to be more than just well built. They've got to be as nearly perfect as it is humanly possible to make them.

No one needs to apologize for what the industry has already done. Our aircraft have stood the test. Piloted by our youngsters—who deserve all credit for their unmatched courage and skill—our planes without exception have been proven in combat to be as good as or better than those of the enemy.

Failed to Stop Our Aircraft

True, the highly specialized, unarmored *Zero* at first was a difficult adversary for our fighters, because of its lightness. True also that at first the Focke-Wulf and Messerschmitt had an edge in altitude over some of our equipment. But the record shows that these advantages, achieved by the enemy at the expense of pilot safety or all-around performance, failed com-

pletely to stop our aircraft from carrying out successfully the assignments given them. And it should be noted that this failure of enemy aircraft has occurred during both offensive and defensive operations.

Nor has American aircraft production been secured by freezing design. Despite steady production increases, month by month, our pilots are being given an always better fighting article.

The *Flying Fortress* and the *Liberator* have been improved from the status of bombers, vulnerable without fighter protection, to the point where today they can range great distances unescorted, able to perform their missions and come back, despite almost suicidal attacks by desperate enemy squadrons. I could run the list of American aircraft, recounting how each has been tremendously improved during the emergency period when quantity alone would have been enough to hope for.

Justifiable Cost

It has been said that the aircraft we've built have cost too much, in manhours and in dollars. And so they have, quite understandably, in terms of peacetime production. A peace-loving nation cannot be transformed almost over night into a fighting machine without some inefficiency and resulting excessive costs. But if our planes had required twice as many manhours to build and twice as many billions to finance, the expense would have been justified if by so doing, we could free ourselves and the United Nations from the evil confronting us. For this reason, our industry, in so many words, had been told to disregard economy of operation *provided* that by so doing, we could accelerate and expand our output to the desperately needed levels.

It was certainly uneconomical, from the standpoint both of dollar cost and pounds of airplane produced per manhour, to ask our employes to work seven overtime-studded days a week. We did not have to be told that an average man's efficiency drops sharply after he has worked forty-eight hours in eight-hour shifts, and those of us who didn't already know soon learned how time-and-a-half and double time affected our cost records when they became the rule rather than the exception.

This continuing overtime effort, far in excess of what might be considered either normal or reasonable, was demanded of everyone in the industry who had special, needed skills or talents, and the response to this demand almost without exception was both enthusiastic and sustained.

I have seen engineers, their eyes showing strain and fatigue, battle a baffling design problem through to the right answer. I have seen production men—foremen, supervisors and plant managers — patiently but doggedly struggle to quicken the educational process, that business of transforming ribbon clerks and pastry cooks, doormen and bartenders, housewives and waitresses into competent turret lathe operators and qualified riveters. I have watched tool designers and toolmakers labor without stint as they built super-precision into the jigs and fixtures required for unskilled men and women to build aircraft. Uneconomical and inefficient are the only words which would describe this process in peacetime.

About the Author

One of the veterans of the industry, Ray P. Whitman, was a co-founder of Bell Aircraft Corp., and is today first vice-president and manager of its Niagara Frontier Division. Whitman's career began in 1916, when he became one of the first three draftsmen in the aviation section of the U. S. Signal Corps. Following our entry into World War I he was assigned to McCook Field in Dayton as an engineer on the development of new types of planes.

In 1921 he supervised construction of the first all-metal day bomber and the first all-metal observation plane designed by the Army. Leaving the Air Corps in 1925, Whitman joined Consolidated Aircraft in Buffalo, becoming chief of inspection. In 1926, he was named assistant to the president, became vice-president in 1928, and in 1929, assistant general manager. When Consolidated moved to the West Coast in 1935, he resigned to join Lawrence D. Bell in organizing Bell Aircraft.

Over-Confidence

Today, we have substantially won the battle of production, insofar as quantity is concerned. We have devised new methods which do work, despite masses of unskilled employes. But the battle of quality can never end, because what is acceptable today, tomorrow will be unacceptable.

Today we are faced with new problems. Across this nation of ours has swept the feeling that the war is as good as won. Too many people say "Oh yes, it may last a while longer, but Hitler is on the run, and even those stubborn Japs for the first time are beginning to back away from the Yanks." Yes, I know how wonderful that feeling of confidence is, and I would welcome its growth, if I didn't know the inevitable re-

(*Continued on page* 267)

HOW CONSOLIDATED

● The predominantly amphibious character of global warfare has thrown into bold relief the role of America's great patrol bombers and transport flying boats. Action in the Pacific theatre is one example of this. There the long sweeping arc of battle stretching from the Aleutians in the north, through the Solomon Islands to Australia in the south, poses unique problems of combat and of logistics.

In this critical situation the huge American flying boats, of which the Consolidated *Coronado* PB2Y-3 is representative, have become important weapons. With a maximum bomb load of 12,000 lb, the *Coronado* is formidable in attack. In the transport version, stripped of armament and bombing equipment, this airplane is capable of carrying heavy loads of men or supplies thousands of miles.

That the *Coronado* was ready to meet these exacting demands was not a matter of chance or accident. The design was undertaken by Consolidated Vultee in 1936. Between that year and the outbreak of the war, all the laborious work of designing, of building, of flight testing, of modification and of tooling up for mass production was accomplished. Today *Coronados* are coming off the moving assembly lines at San Diego in increasing numbers.

Because of its size and complexity, the building of the *Coronado* on a quantity basis was a direct challenge to all currently accepted flying-boat production methods. There was doubt that the moving assembly line techniques commonly applied to smaller aircraft could be employed successfully. Of necessity the plant layout and the tooling setup follows the same massive pattern of the craft itself.

"Coronado's" Great Size

The *Coronado's* wings, from tip to tip, measure 115 ft; its length is 79 ft, 3 in. In flight position, it stands 27 ft, 6 in high. Empty, it weighs 39,600 lb and fully loaded, it grosses over 66,000 lb. In its construction some 500,000 rivets are used, and there are 200,000 parts, bolts and screws; thousands of feet of electrical and control wires; hundreds of pounds of rubber, and more than a mile of tubing. Yet despite its size, every part and every operation of assembly is held to a close tolerance.

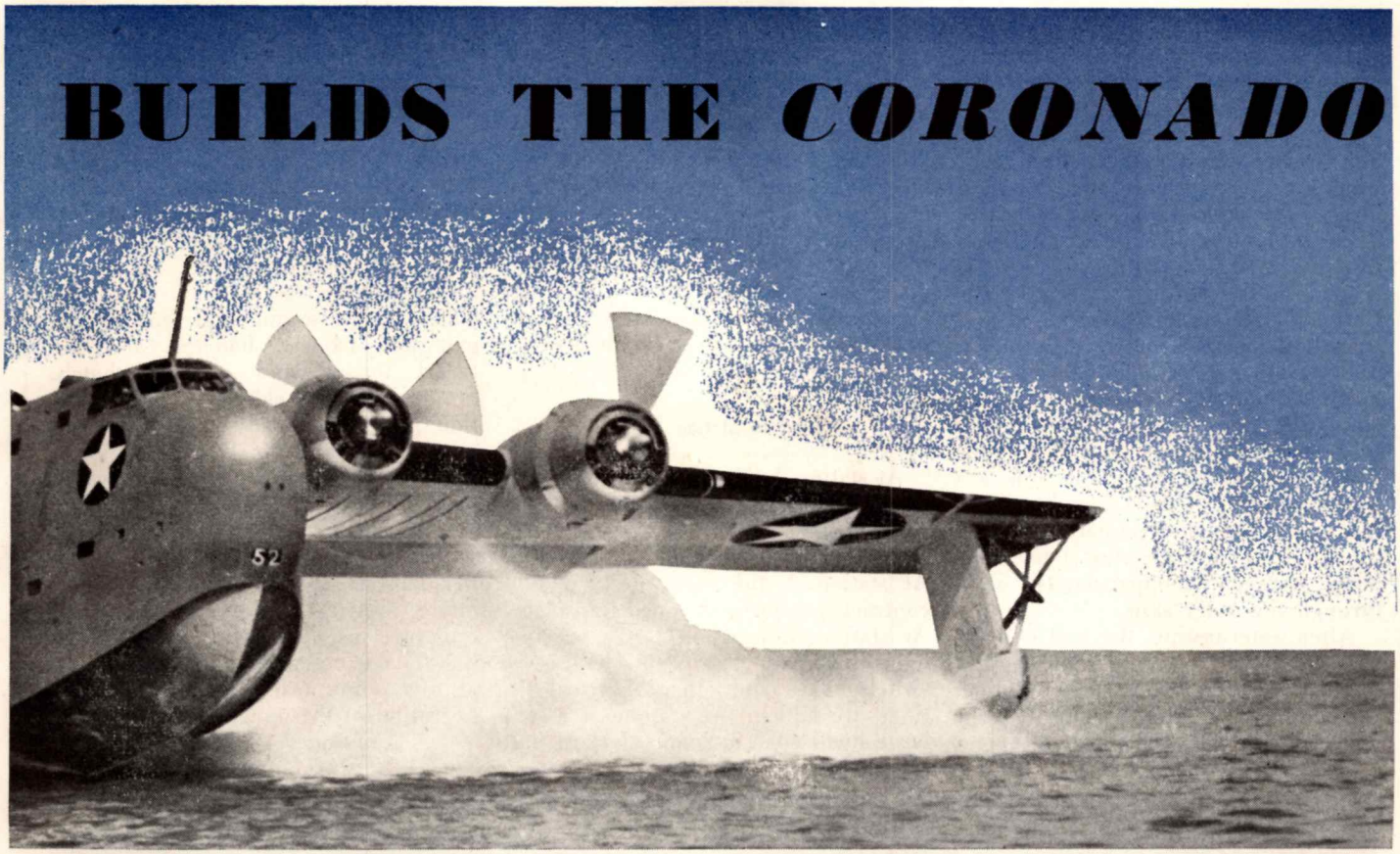
Fundamentally, there are twelve major operations in the fabrication and assembly of the *Coronado*. Of these, three are subcontracted and nine are performed in the plant. Subcontracted operations are the fabrication and assembly of the flight deck and the outer wingpanels; although fabrication of the empennage is subcontracted, assembly of the tail unit is performed in the plant.

In-plant operations are: (1) fabrication of hulls in stationary bucks; (2) water-testing of hulls in fixed bucks; (3) painting of hulls in paint shop; (4) primary assembly of hulls on a moving assembly line; (5) fabrication of center-wing-section panels in stationary fixtures; (6) primary assembly of center wing-section panels on a moving assembly line; (7) final assembly of center wing-section panels and outer wing-section panels on a moving assembly line; (8) assembly of the empennage at a fixed station; (9) mating of wing, hull and empennage on a moving assembly line — from which stage the craft emerges ready for flight tests.

The four moving assembly lines used in these various operations are not in motion continuously. Rather, these lines move intermittently, one station at a time, on a rigid time schedule. At each move, one plane rolls off the line and is sent on its way, and space is made for one new unit at the head of the line.

It is interesting to note that while heavy dead weights are carried on these lines, very little horsepower is required to motivate them. On the final assembly line, for instance, carriage fixtures and assembled planes weigh approximately 375,000 lb. Yet the line is moved easily by a single 3-hp motor operating through a set of reduction gears that steps the rpm

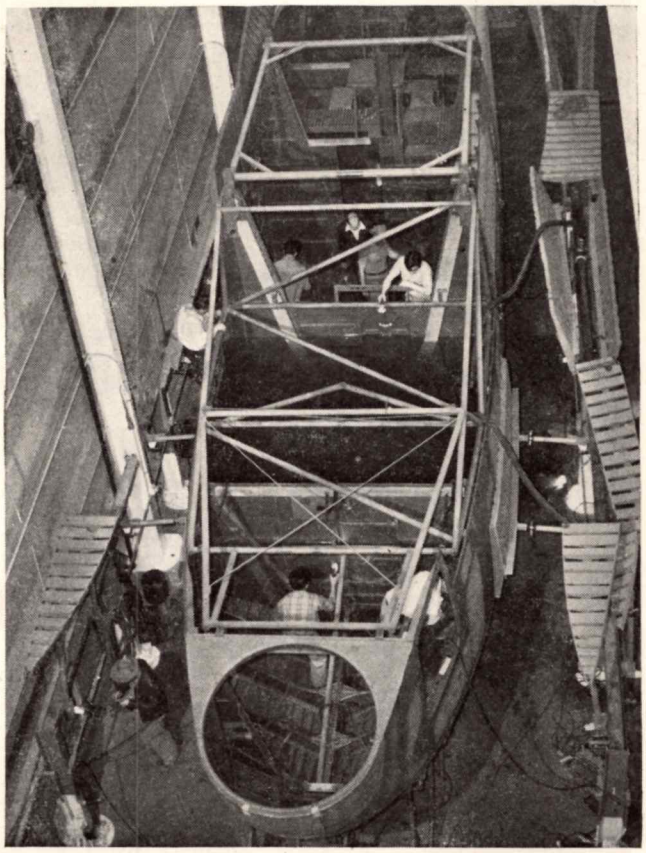
BUILDS THE *CORONADO*

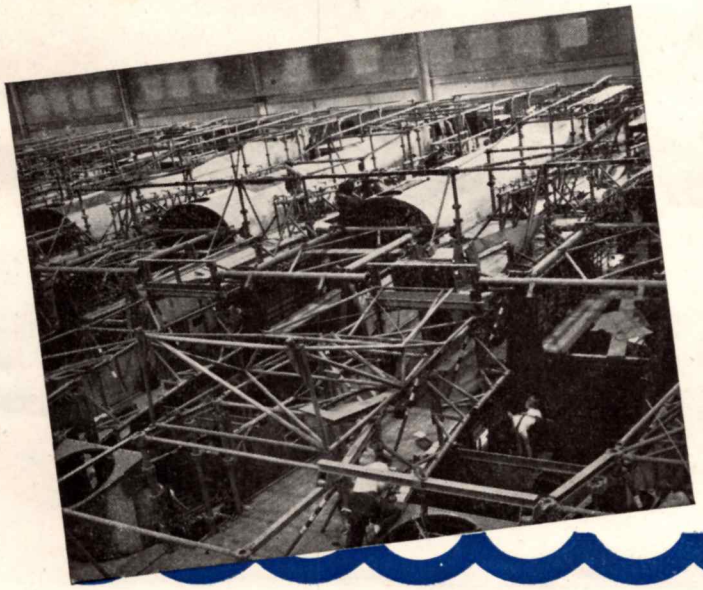


down from 1750 to 13.5. Further reduction results in a final speed of movement of the assembly line of approximately 10 fpm. Other lines, loaded proportionately, are also moved by small motors.

Each unit passing along the lines has its own carriage. The carriages are linked together on the lines by tow bars, so that moving the lead carriage one station draws the entire line forward by that distance. Each station on these lines has its own air and electric outlets. Master connections permit the quick energizing of each

Water test is employed to check the hull and bulkheads of each compartment for leaks. Water pumped into each compartment is allowed to stand for one hour. Visual inspection follows





Left: Fabrication of hulls in fixed jigs is the first major step in the construction of the "Coronado". Here, specialized crews move from hull to hull

unit as it moves from station to station.

The stationary hull bucks have three levels to allow the workers to reach every part of the hull conveniently. The first steps in the assembly of the hull are the placing of the keel, floor frames and watertight bulkheads that divide the hull into compartments. Then the bottom and top stringers are installed and the plating, or skin, is riveted to the hull structure. In the *Coronado* the outer chine is also a structural member.

After fabrication of the shell of the hull is completed, the unit is lifted by overhead crane and carried to the water-test buck where all hull sections that come below the 100-in line are tested for leaks. This is done by pumping water into one compartment at a time and visually checking it for leaks both between compartments and through the outer skin.

After water-testing, the hull is lifted again and carried to the paint shop at the head of the primary assembly line. Here the hull is painted inside and out and made ready for the installation of all the necessary wiring and tubing systems, armament, auxiliary power systems, fittings and equipment on the moving primary hull line.

The moving hull primary assembly line has a total of twenty stations. Operations are divided into two general types. Between stations 1 and 10, heavy mechanical operations are performed, and between stations 10 and 20, light operations, such as wiring, testing, armament installation, clean-up, inspections and so forth are accomplished.

Station to Station Progress

At station 1 the flooring is installed to permit workers to move around the ship through the balance of the operations without damaging the hull skin. At station 2, the flight deck, a subcontracted item, is dropped into place. At station 3, junction boxes, electric light installations, receptacle boxes, switch boxes and other electrical fittings are added. At stations 4 and 5 large items such as bunks, lockers and the auxiliary power unit are installed.

At stations 6 and 7, bracket and cable installations for the surface controls are placed in position. At station 8, fabric items such as stowage bags, securing cords, burgee cords, excess bags, compass stowage and other similar furnishings are completed. At station 9, installation is made of the anchor and mooring hatches, bow-turret and pilot's escape hatches, the main entrance, waist-gun and emergency-exit and camera hatches, and the target towing and pelorous hatch. Station 10 is a clean-up and inspection point where any shortages from previous work are picked up.

Stations 11 and 12 are devoted chiefly to installation of armor plate and armament units. Stations 13 and 14 are concerned principally with the installation of the heating and ventilating systems. Flap fairings, however, are installed here as well as the hull-to-wing attachment plates. Also, at this point, tests are made on the operation of the oxygen system.

(*Continued on page* 186)

The center wing-section, following lubrication in fixed bucks, is assembled on a moving line that has seventeen stations

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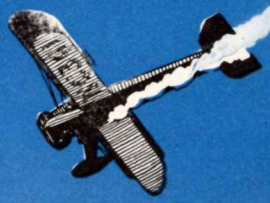

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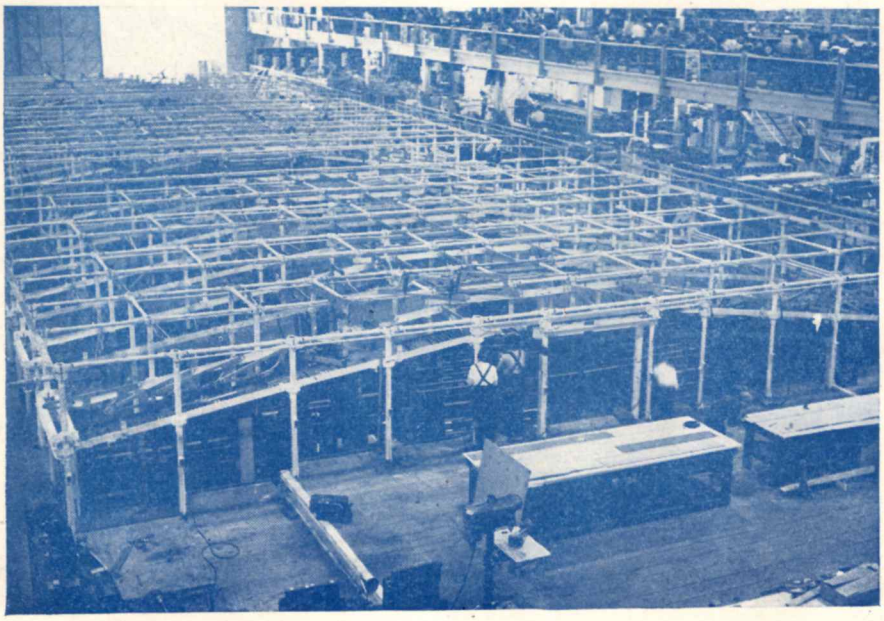

The basic structure of the center wing-section of the "Coronado" is fabricated in stationary bucks. It is then lifted by overhead crane and carried to the first station on the moving assembly line

(*Continued from page* 184)

At stations 15 and 16, the electric conduit is installed for the lighting and control systems throughout the ship. The radio department also makes installations for the bombsight and for interphone equipment. Stations 17 and 18 are used for the actual installation of the ship's electrical systems. At the end of this work these systems are operated and tested for performance. Station 20 is the final clean-up point, where many inspections are made and the beaching gear is attached, preparatory to lifting the completed hull and setting it on the final assembly line.

Wing Construction Noteworthy

Construction of the wing is a noteworthy piece of production engineering in itself. Outer wing-panel sections are subcontracted, but fabrication and assembly of the center wing-section panel, and final assembly of the outer wing panels are in-plant operations.

As with the basic structure of the hull, the fabrication of the center wing-section panel is accomplished in stationary fixtures. It is then lifted by overhead crane to the primary assembly line. This comprises seventeen stations.

The first station on this line, station 0, is not moving, being devoted to the installation of the wing-to-hull attachment fitting, and the clean-up of riveting done in the fabrication fixtures. At stations 1 and 2, holes are drilled for the wing joints between the center section and the two outer wing panels, and for the oil tank supports.

Station 3 is concerned largely with the installation of the oil tanks and the supporting structure for the engines. At station 4, an air test is made on the gas tanks and the bomb bay structure is installed. Station 5 is a paint station where those areas which will be covered in subsequent operations are painted.

At station 6, permanent installation of fairings is made and stubs for the leading edge and flap are mounted. At station 7, front and rear spar tubing

(*Continued on page* 189)

Here are 25,000 lbs of wing, fully equipped with motors, control surfaces, electric and hydraulic lines—ready to be lifted clear and swung overhead to the final assembly line, where it will be carefully lowered into position for mating with the hull

View of the primary hull assembly line; paint shop in the background

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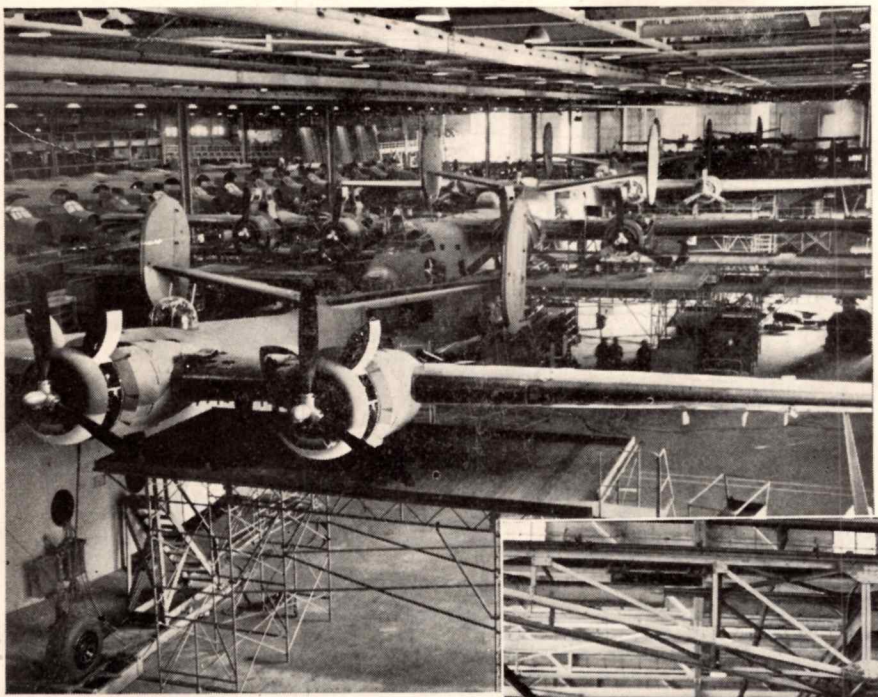
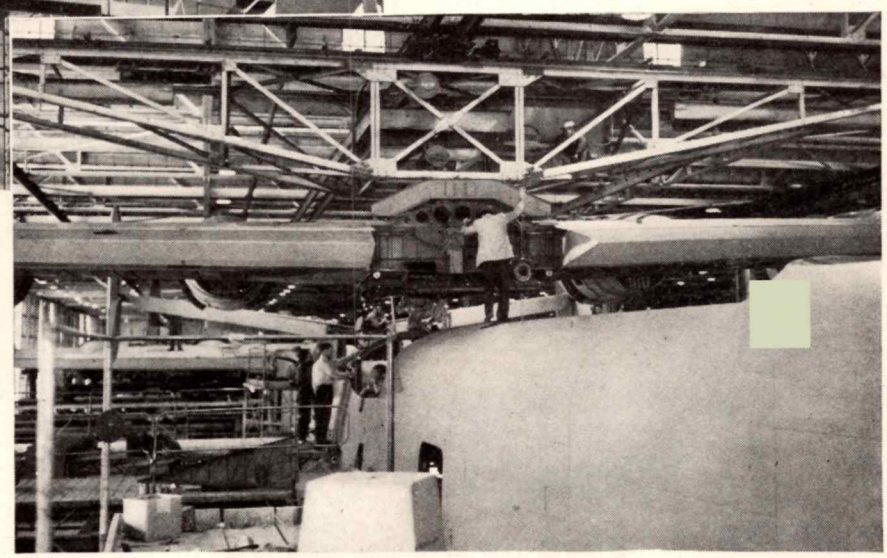


Above: Final hull, wing and empennage assembly line. Work platforms with several levels facilitate the operations as the craft progresses from station to station



Mating of wing, hull and empennage on the assembly line, is an operation requiring the accurate placement and quick attachment of the "Coronado's" ponderous wing

(*Continued from page* 185)

is installed, and the flap-hinge support gear is mounted. At station 8, the bomb release system is installed and the oil tanks are mounted along with the oil tank armor plate.

Station 9 is used for the installation of the front and rear spar conduits and junction boxes, and for the installation of bomb door tracks and beams. At station 10, power-plant controls, cables and brackets are installed, as well as conduits in the bomb bays. The trailing edge skin is also put in place here and the final air test made on the gasoline tanks and tubings.

Stations 11 to 17

Station 11 is reserved for painting, and as a safety measure, no other work involving the use of lights or electric driven tools is permitted. Station 12 is given over to the installation of electric wiring for the bomb bays, the installation of fuel cells and the closing of the gas tanks, and to the installation of the lower bomb bay doors and the front spar electric wiring. The installation of wiring begins at station 12 and is completed at station 13.

At station 14, oil-filters and coolers are installed, lower fairings fitted, and armor plate for the oil system is mounted. Stations 15, 16 and 17 are devoted to final clean-up and inspections. The installation of bomb bay doors and drops is here finally completed.

From the primary line, which is located at Plant 2, the center wing section panel is taken by truck and trailer to the start of the final wing assembly line at Plant 1. Here there are five stations. At station 1 of this final wing-assembly line, installations of subassemblies such as ailerons, de-icer boots, etc., are made on the outer wing panels, which have come from a subcontractor. Also any modifications on the two outer wing panels made necessary by design changes are accomplished here.

At station 2, the center wing section and the two outer wing panels are mated and installation of the wing flap is begun. Electrical lines between the center section and the two outer wing panels are also connected. At station 3, the engines are installed. At this station, also, the wing floats, which retract in flight to form the wing tips, are installed.

Stations 4 and 5 are clean-up and final inspection stations. Controls, de-icer boots, engine and all wing installations are inspected and stamped off. Float tips are operated and checked in a pair of pits that permit the floats to drop below the floor level.

The empennage is a wholly subcontracted unit with the exception of its assembly and the installation of the de-icer boots. In one floor area, several units are assembled at the same time. Often, considerable modification of the parts as they are received from the subcontractor must be made to accommodate current design changes.

With the hull and empennage completed, the three major parts of the *Coronado* are ready for transfer to the final assembly line for mating, and the full integration of all the control, electrical fuel and communication systems that have previously been installed in the wing, fuselage and empennage.

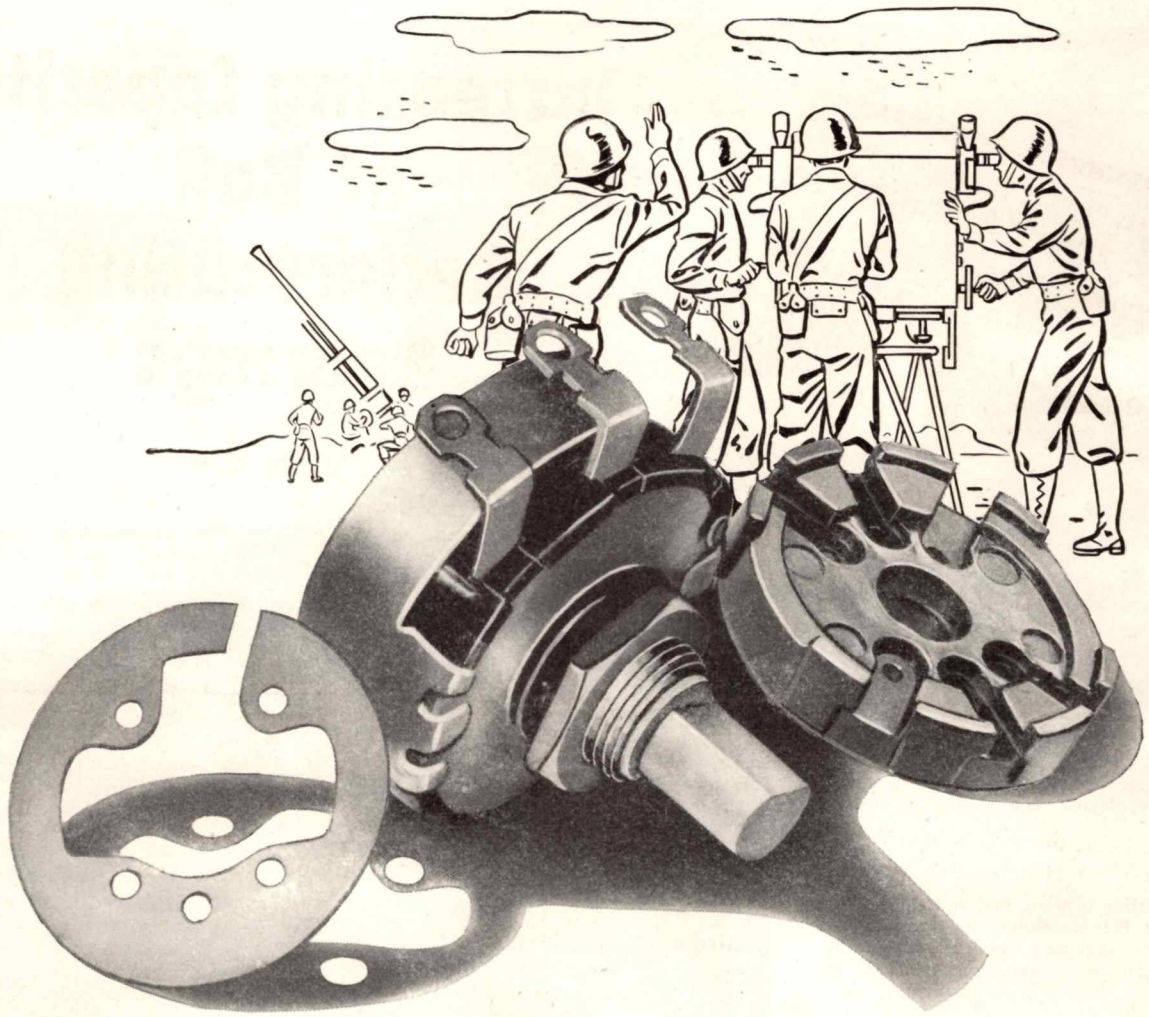
The transfer of these units is accomplished by the overhead crane system. First the hull, weighing 15,000 lb at this time, is lifted off the hull line and carried over to station 1 on the final assembly line. Then the empennage is carried over and mated with the fuselage. Finally comes the wing, which now tips the scales at about 25,000 lb.

Fitting Wing to Hull

Here, by very sensitive electric controls on a special overhead crane mechanism, the great wing is lowered into place in small movements that can be regulated to 1/1000 in. When the wing fastenings have been perfectly aligned with the matching fittings on the hull, bolts are inserted, nuts screwed on and cotter pins driven home.

Station 2 is devoted to the complete hookup of all the electric wires, the

(*Continued on page* 250)



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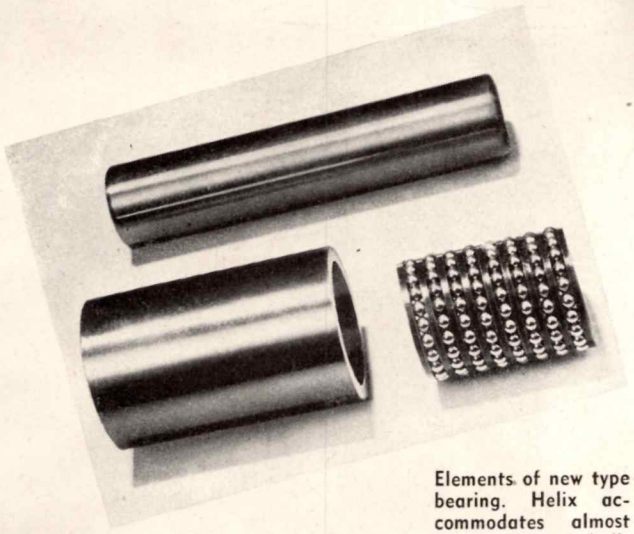
Increasing Capacity of Ball Reciprocating Bearings



Elements of new type bearing. Helix accommodates almost twice as many balls as old type cage

S. R. THOMAS
Chief Engineer, Bantam Bearings Div.,
The Torrington Co.

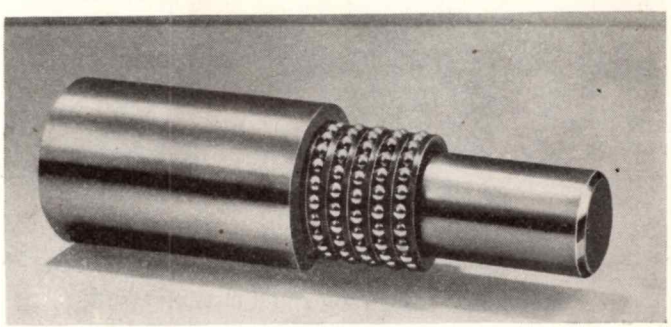
● What has commonly been called by manufacturers a "ball reciprocating bearing," may more appropriately be described as a bearing capable of both rotation and axial reciprocation. Such a bearing has no definite ball tracks or grooves, since sometimes rotation only and at other times only axial reciprocation is called for. For this reason the outer raceway is a true hardened and ground cylinder. The inner race is either the outside diameter of a cylinder of the surface of a hardened and ground shaft. The balls lie between the two surfaces and are generally retained by pockets in a metal cylinder serving as a retainer.

It is well known that a ball pressed against a flat plate or, particularly, against a surface whose curvature is opposite to that of the ball radius, has less load-carrying ability than when the same ball is placed in a groove similar to that of a conventional Conrad type ball bearing. This ratio lies in the neighborhood of one to ten.

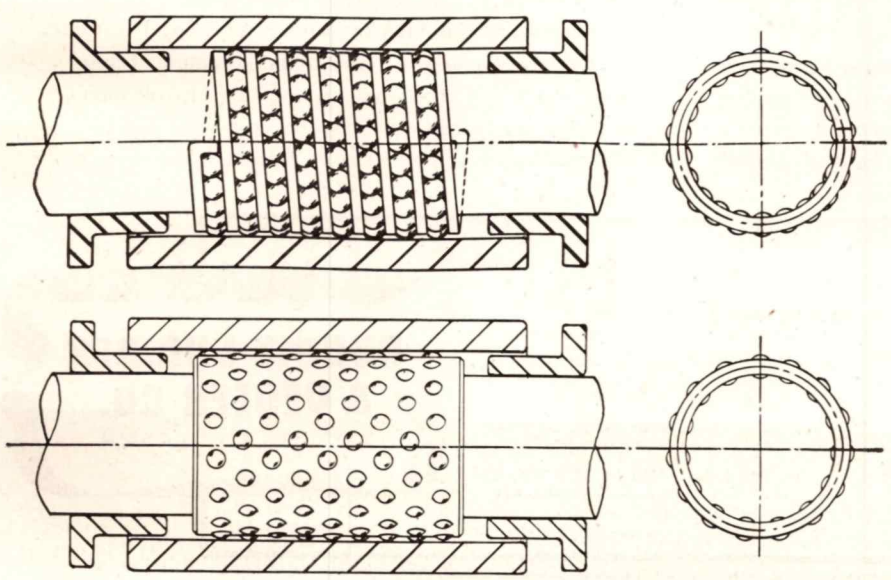
To secure the greatest load carrying capacity for a given size of bearing, there are but few alternatives. One of these is to provide the highest possible hardness and uniformity of parts, in view of the fact that all contacts are minute ellipses of very limited area, and the harder the parts, the greater the unit pressure that can be applied. Another involves accuracy of manufacture and proper design, so that the load will be distributed uniformly over the bearing.

The third alternative forms the main subject of this discussion. By increasing the number of balls in the same size bearing, a proportionate gain in capacity is attained. Thus, if twice the number of balls are installed the capacity of the bearing is doubled. To accomplish this, the usual type of ball cage, consisting of a cylinder laid out and drilled to form as many ball pockets as possible per inch of cylinder length, is supplanted by a construction comprised of spirals of balls separated by coils of a specially formed helical spring (fig. 1). The section of this wire may be triangular, round, square, or rectangular, but by making it hourglass shaped, it not only facilitates the loading of the balls, but retains them at all times until the unit is installed between the races.

Right: New bearing unit assembly. Added balls increase load capacity



Below: fig. 1, at top, shows new spiral cage construction with balls arranged in helix; fig. 2, at bottom, conventional type of ball retainer



In the conventional type of ball retainer (fig. 2), it is apparent that the number of balls is limited by the minimum space necessarily taken up by retainer metal for staking the balls in place.

Referring again to fig. 1 it will be noted that the balls are restrained from the end exit by the formed ends of the helix. When this bearing is used in rotation only, the helix of the retainer so positions the balls that each has its own special path.

(*Continued on page* 272)

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LOFTING PROBLEMS of *Streamline Bodies*

[PART 17]

CARTER M. HARTLEY, Chief Loftsman, and
ROY A. LIMING, Charge, Lofting Engineering Loft Mathematics,
North American Aviation, Inc.

THE problem presented by the need for providing coordinate information relative to fuselage station contours has never been successfully solved by the application of traditional lofting methods.

Following traditional procedures, subsequent to the establishment of the basic fuselage lines layout, an ordinate chart was prepared showing scaled offset values from the centerline of ship (buttock values) and from the fuselage reference line (waterline values). The preparation of this chart, seemingly undertaken as an after-thought, inevitably led to a finished product of such a character as would naturally be expected of an analysis both empirically inadequate and applied only incidentally.

Chart Preparation a Routine Formality

The shortcomings of such data have been so pronounced as to reduce the preparation of such charts to a routine formality, indeed, perhaps only to satisfy some pre-established requirement already outmoded through ineffectiveness of application.

The disadvantages of data thus compiled are numerous:

(1) Time lag between release of original lines data to the loft and final release of the charted data
(2) Lack of actual coordination of scaled data with existing lines
(3) Inaccuracies in scaling due to the human element
(4) Lack of a positive, objective method of checking scaled dimensions
(5) Lack of precision equipment for scaling offsets.

(*Continued on page* 195)

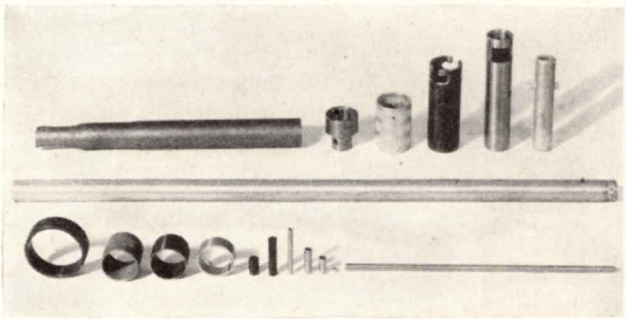
Merle Beaupre (left) and Richard F. Pribil of North American Aviation's confidential design group discuss structural design affecting fuselage and wing coordination of new P-51 with the Merlin motor installation

Ceiling ZERO? Not any more!

"Groundwork" for precision machining of aircraft parts laid by OSTUCO

When American planes, with now-established superiority, form their "umbrellas" over enemy positions, they carry with them the best wishes, hard work, and precision equipment of many American manufacturing companies. Among these are manufacturers of such parts as generators, energizers, starters and other accessories.

Photo Courtesy Jack & Heintz, Inc.



To speed this work, OSTUCO supplies seamless steel tubing to required military specifications, with the necessary machining properties. OSTUCO's experienced workmen, some of whom have been producing seamless tubing on the same spot for fifty years, are constantly gaining new experience from their efforts to better the company's enviable record of low rejections and "on time" deliveries — from ever-changing war demands.

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(*Continued from page* 193)

It is obvious that carefully and systematically prepared charts of fuselage data, coordinated precisely with the actual fuselage lines, and so organized as to provide a complete and adequate picture of the dimensional features of each given fuselage frame, would fill what now amounts to an appreciable gap in the sum total of basic dimensions which should be available on the airplane.

Such information, including waterline-buttock line offsets for all desired fuselage stations (normal and canted), stringer coordinate data and longeron basic data, would be of direct and positive value in the following functional respects, providing:

(1) A check upon the accuracy of basic body plan view lines of the fuselage during the lofting process

(2) A check upon the accuracy of fuselage contour templates of all types

(3) Engineering reference data for the development of body plan contours, whole or in part, to any desired scale

(4) The means for establishing any required point on the fuselage molded surface by direct calculation

(5) The basis for advance release of critical dimensions for engineering design and tooling use

(6) The means for advance establishment of one centralized body of coordinated dimensional data for the use of engineering, lofting, tooling, and inspection.

Establishment of Offset Data

With the use of appropriate conic techniques, the establishment of waterline and buttock line offset data is a purely mathematical routine. From the conic equations of the basic fuselage lines, including the upper and lower centerlines, the upper and lower shoulder lines and the maximum half-breadth line, the intersection points of these lines with the plane of a given fuselage station may be directly computed.

Thus (see Chart 6) the intersection of a given station plane with the basic fuselage lines establishes the control points for the upper and lower contours of a typical frame. The coordinates of these points supply the loftsman with the data necessary for the development of the body plan contours as conic sections. This development may be accomplished graphically where the small size of the layout renders such a procedure desirable.

However, the plotting of the calculated points, tabulated as shown in Chart 6, will enable the loftsman to establish the required contours without resorting to a graphical analysis to determine points on the curve. The construction of an accurate grid as a preliminary step will greatly facilitate the mechanical plotting of points from a chart of calculated coordinate data.

The calculation of buttock line intersections with a body plan contour may be carried out as indicated in Chart 7. Such calculations are based upon the original equation from which waterline intersections are determined. Through this procedure both waterline and buttock line offsets may be considered as derived from a common basic equation. Maximum economy of time and effort is thus provided for in the routine calculations required.

Cross Checking of Methods

Regardless of the procedure adopted, the one method employed may be checked by judicious application of the other. In the case of frame contours of small magnitude, graphical development using calculated control points may appear most feasible. In the case of relatively large cross-section curves, the plotting of calculated coordinates appears to be the logical choice.

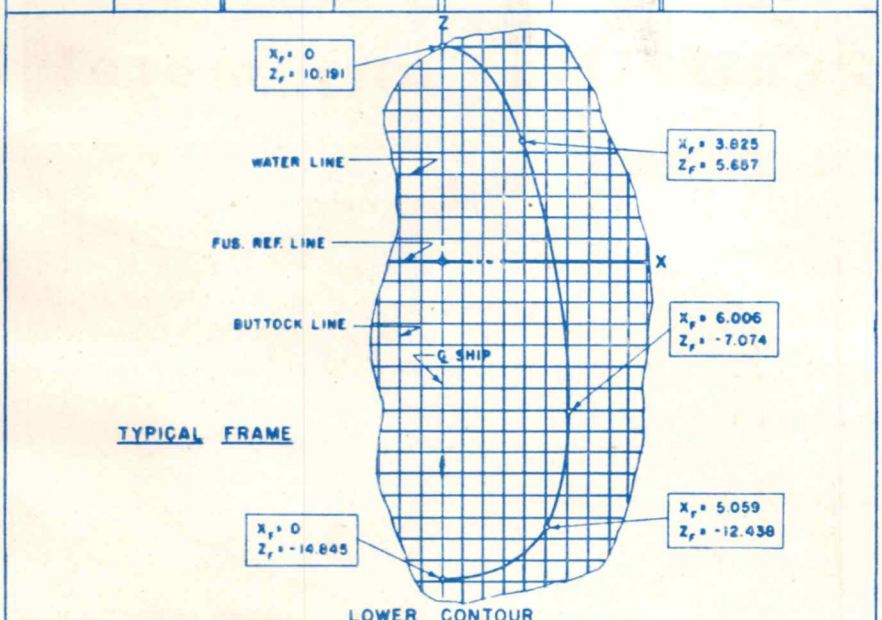
The engineering designer and draftsman may elect any one of three procedures to secure a needed contour. He may employ the given control points, especially convenient for reduced scale development, or he may plot offset data to develop the required contour, or any part of the contour desired. A third procedure is the tracing of the loft lines on vellum, provided that the lofting process is far enough along to make such lines available. Calculated data

(*Continued on page* 197)

Chart 6

UPPER CONTOUR

WATERLINE	OFFSET	WATERLINE	OFFSET	BUTTOCK	OFFSET	BUTTOCK	OFFSET
Z_f	X_f	Z_f	X_f	X_f	Z_f	X_f	Z_f
10.191	0			0	10.191		
5.657	3.825			1	9.880		
5	4.071			2	8.976		
2.5	4.827			3	7.457		
0	5.368			3.825	5.657		
-2.5	5.736						
-5	5.949						
-7.074	6.006						



LOWER CONTOUR

WATERLINE	OFFSET	WATERLINE	OFFSET	BUTTOCK	OFFSET	BUTTOCK	OFFSET
Z_f	X_f	Z_f	X_f	X_f	Z_f	X_f	Z_f
-7.047	6.006			0	-14.845		
-7.5	6.002			1	-14.802		
-10	5.802			2	-14.647		
-12.438	5.059			3	-14.322		
-14.845	0			4	-13.711		
				5	-12.496		
				5.059	-12.438		

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(*Continued from page* 195)

may be established considerably ahead of the actual lofting of the lines.

In resorting to the tracing-on-vellum method, the draftsman is limited to fullscale reproduction of the desired contour. The value of calculated data, coordinated with the actual lines, is thus readily apparent. Furthermore, any desired theoretical section may be developed from calculated control points without requiring the formal lofting of such lines until it has been definitely established that such lines will be actually needed. The saving of time and expense involved in this respect is quite obvious.

Calculated control points may be rushed into mock-up without the delay necessitated for the development of the regular lines layout. Design procedures may thus be greatly accelerated in this stage of the airplane's development.

In addition to normal fuselage frame contour data, all canted frames may be established by calculation procedures* referred both to the fuselage reference system and to the true view of the given frame. The former body of data establishes the precise location of the canted frame with respect to basic fuselage elements; the latter data govern the flat pattern development and tooling requirements referred to the actual plane of the canted frame.

CURVE STA. 000.0 (UPPER CONTOUR)

FOR CALCULATION OF $X = P'Y \pm \sqrt{RY^2 + SY}$ FROM $Y = PX + Q \pm \sqrt{RX^2 + SX + T}$

WHEN ONE TANGENT COINCIDES WITH THE X-AXIS & THE OTHER IS PERPENDICULAR TO IT

$B = 17.265$ $C = 6.006$ $P = .092408$ $Q = 4.410581$ $R = -.11247534$

$U = (B/C)^2 = 8.26347104$ $P' = PU = .763610832$ $S' = 2QU = 72.8934167$ $R' = RU^2 = -7.68037338$

STATION	Y	A		C	X	Z_F
X_F	$6.006 - X_F$	$P'Y$	Y^2	$\sqrt{RY^2 + S'Y}$	$A \pm C$	$X - 7.074$
0	6.006	4.5862	36.072036	12.6788	17.2650	10.191
1	5.006	3.8226	25.060036	13.1314	16.9540	9.880
2	4.006	3.0590	16.048036	12.9906	16.0496	8.976
3	3.006	2.2954	9.036036	12.2359	14.5313	7.457

Chart 7

Value of Conic Lofting

The use of conic lofting techniques makes possible a more complete dimensional picture on longeron structures than has hitherto been available. In addition to fuselage station (y) values and waterline (z) values, buttock (x) dimensions may be calculated. Thus a complete coordinate description of basic longeron points may be developed purely by calculation procedures. Such information is especially important in establishing jig structures, since longeron locations are basic and critical in a given fuselage frame structure.

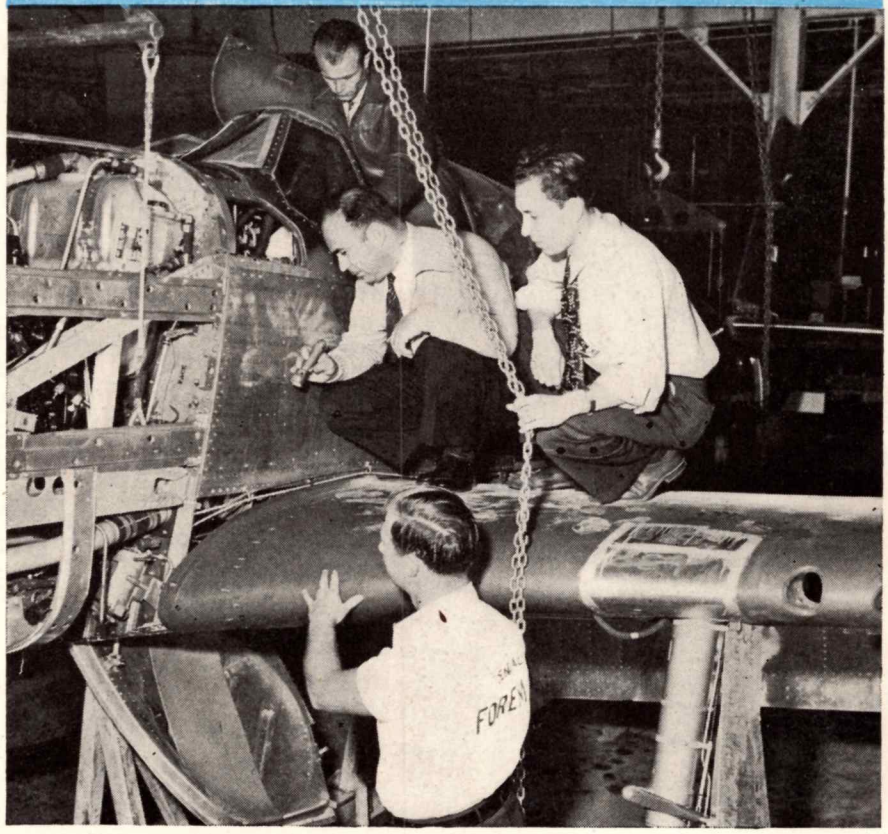
The design of longeron fittings and the structural tie-in of related members may be easily and directly correlated with the longeron. Mathematical development of fittings not conveniently susceptible to layout methods is merely a matter of adding to the picture already established. Analytic analysis of straight line elements and planes may be correlated with the analytic description of contours, to insure perfect coordination of structure in assembly procedures.

The actual calculation of the additional x (or buttock) dimension in the case of the typical longeron, which appears as a straight line in the side view, involves merely substituting the waterline (z) values for a given fuselage frame station in the already established body plan contour equation.

The same complete body of coordinate data may be compiled to describe fuselage stringers. Where such structural members are designed as straight line elements in the side or profile view, the same calculation procedure may be applied as has been indicated in the case of longerons. Such information, properly tabulated constitutes a valuable source of engineering information, directly accessible to the designer and draftsman.

The jig builder likewise has a timely source of pertinent data, which, since available to inspection in the same convenient form, insures both functions adhering to a common dimensional standard. This feature of availability of a common source of coordinating dimensions for all functions in engineering, lofting and tooling, particularly when inspection procedures are known to be based upon such data, tends to promote a positive and constructive program of dimensional applications.

Dimensional coordination insures smooth mating of fuselage and wing



*See "Lofting Problems of Streamline Bodies," Part 14—AERO DIGEST (June, 1943).

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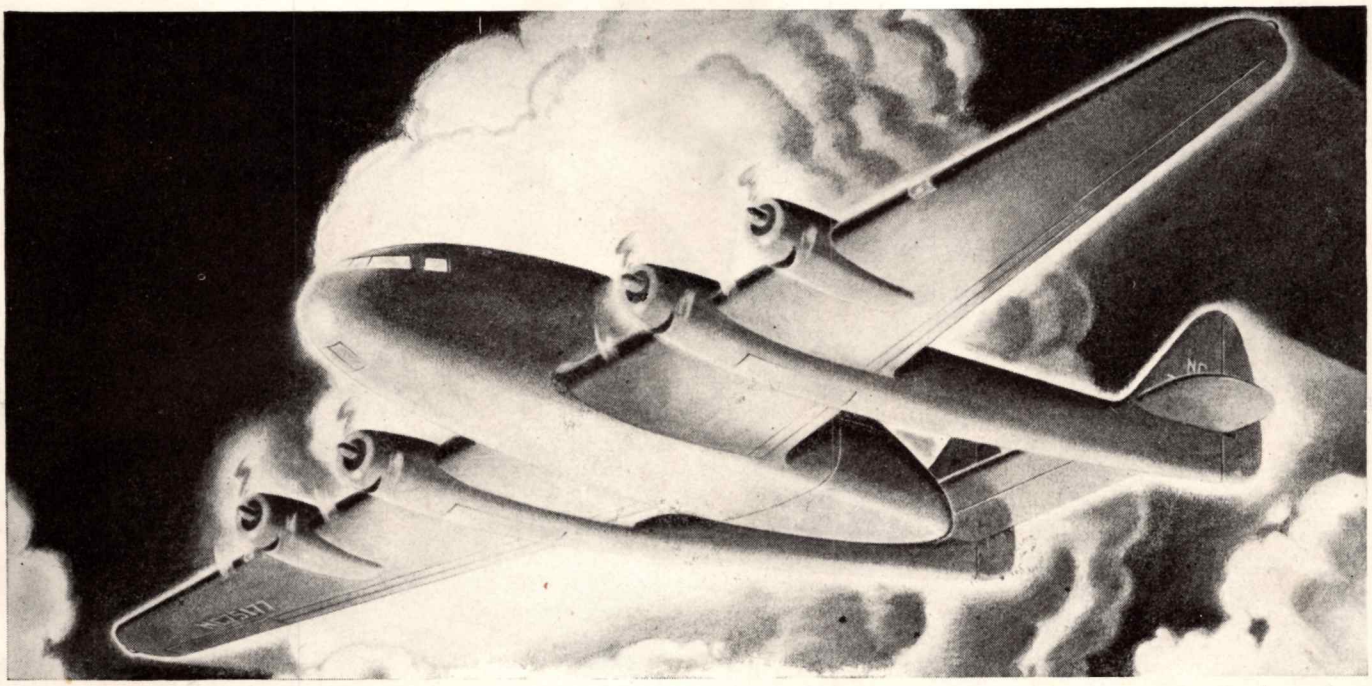
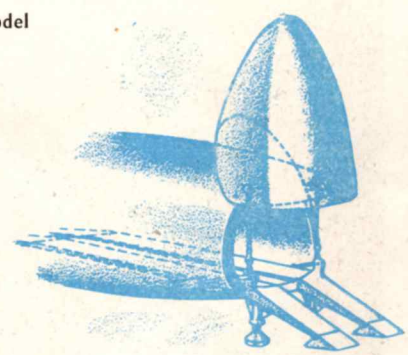


Artist's conception of new cargo airplane, four-engined model

Martin Engineer Designs New Cargo Plane



Sketches showing cargo compartment of Martin cargo plane. Tricycle landing gear keeps aircraft in flight position during loading or unloading operation

● A new type of cargo airplane designed specifically to facilitate the handling of freight has been developed by William D. Van Zelm of the Glenn L. Martin engineering department. The disposition of its structural members has been planned so as to provide for the accommodation of bulky cargo, and arrangements for simplified loading and unloading are important features.

In anticipation of post-war demands, designs for both a twin-engined and a four-engined cargo airplane have already been drawn up. The two models are low-wing monoplanes. The twin tail surfaces in both models are independent of the fuselage and are attached to extensions of the engine nacelles. In the four-engined plane, the extensions run back from the inboard engines. The cargo compartment is in the fuselage, the aft end of which opens like a door to permit the easy loading of freight.

The same hydraulic mechanism which raises the cargo door operates to extend a collapsible loading ramp that can be adjusted to run either to the ground or to the back platform of a truck. The ramp itself is equipped with adjustable jacks close to the point where it hinges onto the plane, so that the cargo does not exert any strain on the floor of the fuselage during loading operations. A tricycle landing gear keeps the plane in level or flight position while it is being loaded or unloaded.

Automobiles, wagons, trailers or other wheeled freight can be run or pushed directly into the plane, and as the loading is done through the aft end of the fuselage, no juggling or turning is necessary once the cargo is aboard. Boxed freight is drawn aboard by means of a winch.

As to size or weight, there are said to be no limitations in the design of this airplane. Wing area, wing position, number of engines and overall size can be varied just as in more conventional aircraft. In the two models so far designed, the twin-engined type has a gross weight of 60,000 lb, the four-engined plane—86,000 lb. The latter has a useful load of 36,870 lb, of which 27,000 lb represents cargo capacity.

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HAND-STONING CONSERVES CUTTING TOOLS

How hand stoning, after rough grinding, saves time and vital machine tool steel

● The critical shortage of tool steel today, and the consequent importance of conserving it, fix a more than ordinary emphasis upon procedures which will provide the utmost in tool efficiency and longevity. As an evidence of this, the hand-stoning of cutting tool edges is becoming more and more nearly a universal practice in the machine shop.

The edge of the average cutting tool, immediately after grinding, is not a straight, unbroken line. When placed under a microscope, it is seen to be deeply serrated. Minute peaks and valleys are revealed along its length (fig. 1).

When the cutter goes up against the work once more, these peaks, or high points, bear the brunt of the load entailed by the cutting operation. They break off, leaving dull spots (fig. 2), which rub instead of cutting —and generate an undue amount of heat. Such a tool soon becomes dull and must be reground.

The elimination of these microscopic but nonetheless significant peaks and valleys on the cutting edge is the function of hand-stoning. Application of an oilstone several times finer than the surface of the grinding wheel readily reduces the high spots and produces a firm, unbroken line at the junction of the two planes which form the acute angle of the cutting edge (fig. 3).

This sharper and more solid edge cuts better and lasts longer. Furthermore, the surface of the work is bound to be smoother.

Two basic stones are used for hand-stoning of cut-

(*Continued on page* 267)

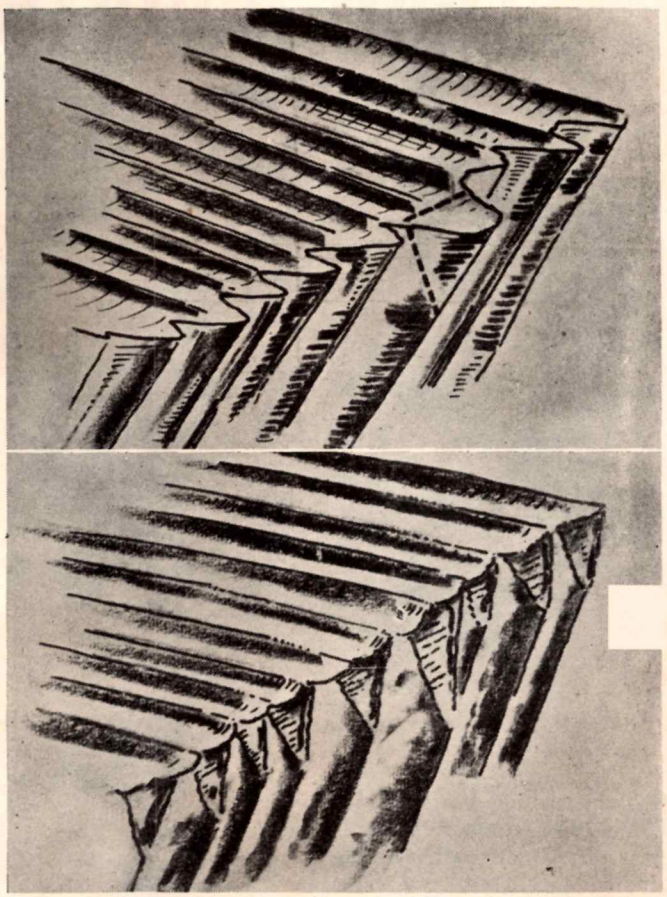


Fig. 1, at top: Rough ground cutting edge. Note hills and valleys created by grinding wheel. Fig. 2, just above: The peaks (see fig. 1), unequal to heavy load imposed upon them, break off, quickly dulling the edge

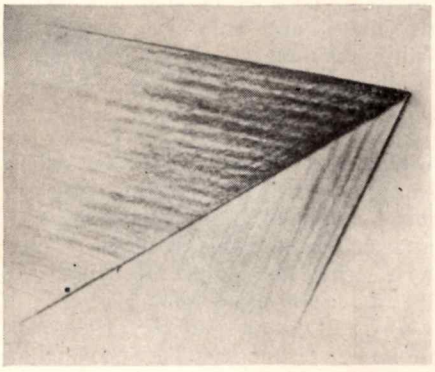
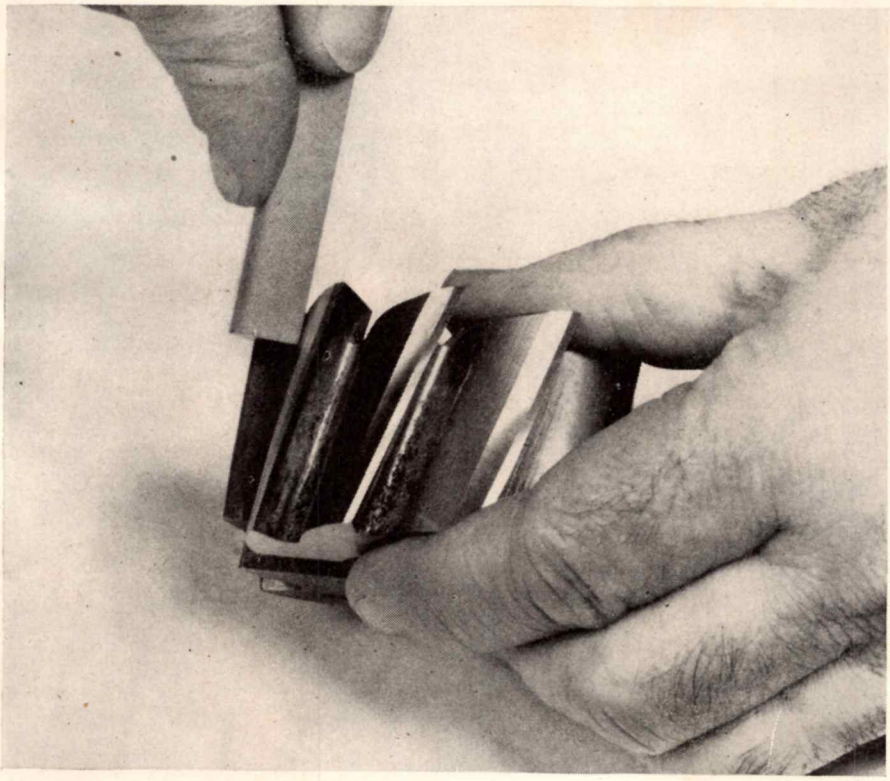


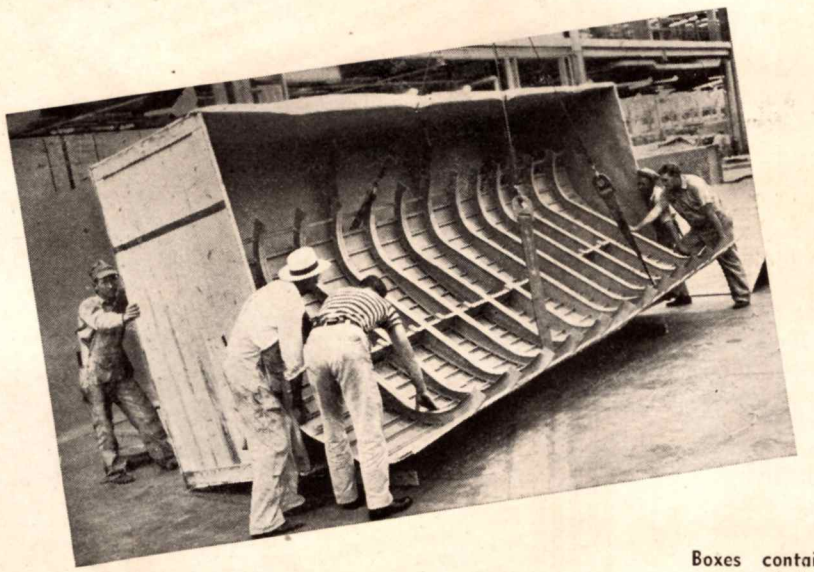
Fig. 3, above: A good cutting edge should be as nearly an unbroken line at the junction of two planes as it is possible to obtain



Left: Use of Hard Arkansas oilstone in hand stoning of end mill cutter edges

Behr-Manning illustrations

OVERSEAS SHIPMENT OF SPARES AND MAINTENANCE PARTS



Part of a "Liberator Express" transport being made ready for shipment overseas

Operating as a factory within itself, except for actual fabrication of parts, the Spares division at Fort Worth has its own ordering, expediting, storing, inspection and records groups.

Shipped in "echelon pack-ups" containing enough parts to maintain a given number of *Liberators* for three months or more, each crate is duly labeled and waterproofed before it leaves the factory. Echelon pack-up No. 1, for instance, contains almost 14,000 parts which will service 40 *Liberators* for 90 days under normal combat conditions.

Boxes containing thousands of "Liberator" parts ready for delivery to all parts of the world

● To perpetuate the unremitting aerial bombardment now being unleashed on Axis targets, aircraft spares and maintenance parts must go overseas in a steady ever-increasing flow. The parts most often damaged in combat, and hence frequently needed are spare engines, landing gear and control surfaces. For these, and other replacement items, manufacturers receive emergency requests from the Army Air Forces which must be answered within two hours and shipments completed within a single day. So it is wholly a shipping problem, and not a production one.

Only a year ago the deadline for shipments was 10 days before sailing time. Using transport planes, parts can now be shipped as few as 24 hours in advance, to Atlantic, Gulf or Pacific ports, when the points of origin are less than 2000 miles inland.

An outstanding example of this voluminous wartime traffic is presented by Consolidated Vultee's Fort Worth plant, from which some 600,000 parts, aggregating 800 tons, are being shipped abroad every month. Parts ranging from cotter pins to outer panels are shipped by rail, truck, boat and air express to all parts of the world. Shipping tags are used at the rate of 5,000,000 a year.

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It's Okay, Mom

We have this to say . . . to a lady whose boy has gone to war. All of us here in America want our fighting men to come back.

To help bring them safely home, we're giving them the best equipment we can produce. The finest of food, clothing, medicine, guns, tanks, planes.

That's why planes like the U. S. Army Bell Airacobra are designed with stout armorplate protecting the pilot . . .

With self sealing gas tanks . . .

With bullet-resistant "armor glass" . . .

With a 37 mm. cannon in the nose. (After all, an explosive cannon shell hurtling at the enemy is a pretty good protective device!)

These and all the other safety features built into American planes add weight, make design problems tougher. But they'll bring safely home many an American boy who might not have come home without them.

WHEN they come home, they'll want planes of peace. There'll be another era of aircraft pioneering—this time to make planes still safer, simpler, more useful, more economical. You'll see then how an aircraft manufacturer could pack decades of aviation progress into a few short years of war. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

BELL *Aircraft*

AIRACOBRAS for victory—future planes for peace

"VISUALS" SAVE PRODUCTION TIME BY SIMPLIFYING DRAWINGS

L. S. SANDERS

President, Craftint Manufacturing Co.

● In these days of high pressure and round-the-clock production, with hundreds of thousands of unskilled, or at the best, semi-skilled workers employed in aircraft plants, it has been found necessary to simplify and systematize every phase of factory operation.

Training production workers means more than teaching them to use their hands. In a great many instances they also must be taught to work from drawings, and this instruction may involve just as much time as teaching them manual skill. Mechanical drawings to many people remain a permanent enigma, and much time is consumed in unravelling their mysteries. On the other hand, give the worker a drawing which he can understand at a glance, and much valuable time is saved, which is reflected in increased production.

The one type of drawings which has been found universally practical for the use of aircraft workers is the three-dimensional "visual." These drawings (figs. 1 and 3), while purely mechanical in nature, give perfect stereoscopic depth and roundness. In this way the worker gets an accurate picture of what he is making. Nothing is left to the imagination; constructional details are brought out with accuracy and clarity in contradistinction to the conventional mechanical drawing (fig. 2).

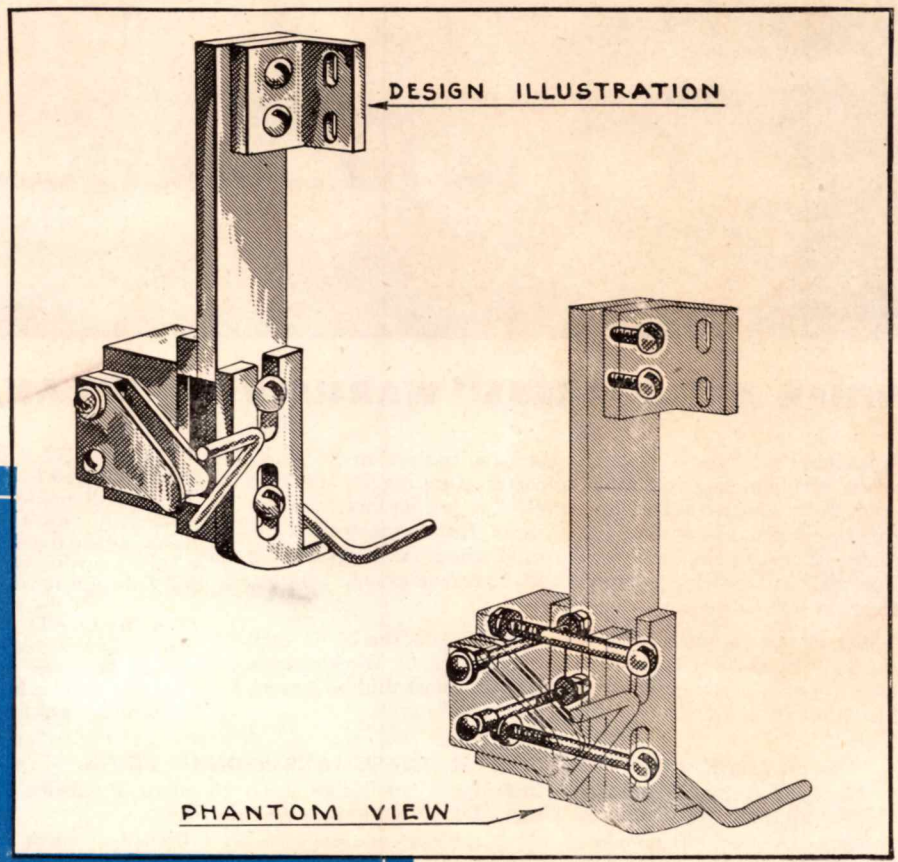
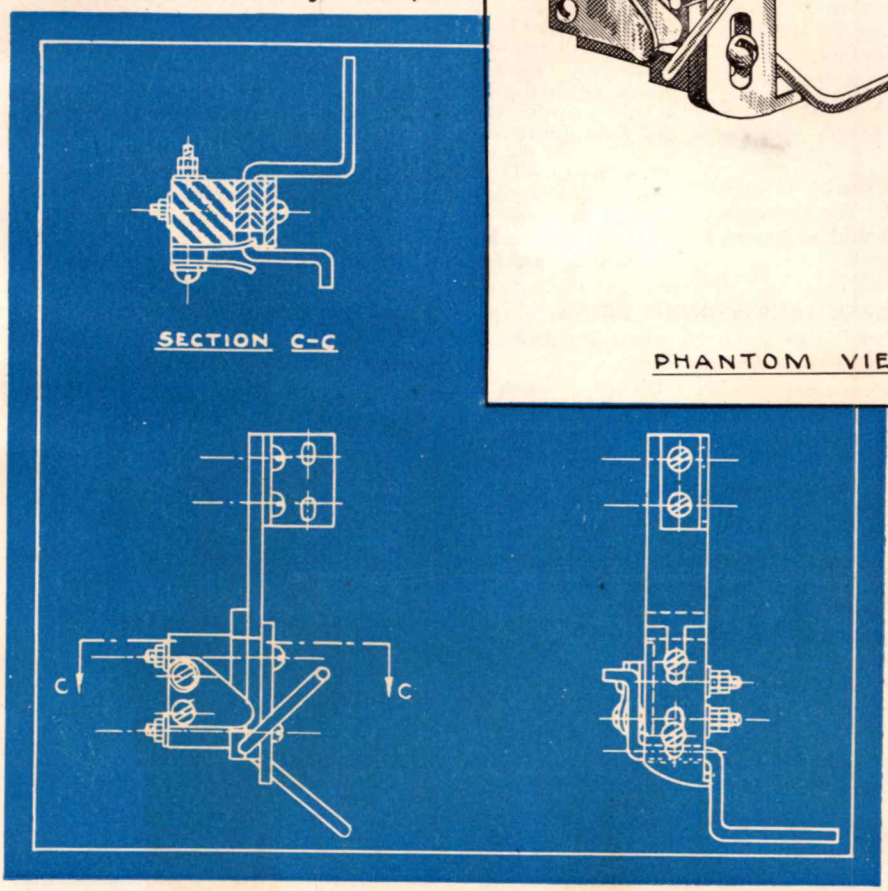


Fig. 1, right: "visual" drawings of a part. Note stereoscopic depth attained. Fig. 2, below: conventional mechanical drawing of same part



It easily becomes possible to effect a saving of as much as two-thirds in the time required for a particular operation. One airplane manufacturer, as a direct result of the use of three-dimensional drawings in place of the time-honored blueprints, actually reduced construction time on a certain job from 5.4 to 1.9 hours. The use of "visuals"

(*Continued on page* 207)

WHEN A "FORTRESS" WARMS UP FROM AN ARCTIC COLD START?

Imagine the severe pressures that oil coolers must stand when airplane engines start up after standing in sub-zero cold. Actually, pressures up to 300 lbs. per square inch are thrust against the walls of the tubes. But Winchester Cartridge Core Tubes safely withstand them . . . keep Flying Fortress* oil cooling systems safe from clogging, leaking, freezing or overheating.

Made of pure copper, with walls only 6/1000ths of an inch thick, Winchester Radiator Tubes, thanks to Winchester's COLD copper-extrusion process, are seamless and so assembled that *their entire outer surface is cooling area.*

WINCHESTER RADIATOR TUBES RESIST CORROSION... DEFY BURSTING. Pure copper, Winchester Cartridge Core Tubes will not corrode under regular operating conditions. And they won't burst from freezing, because the coolant flows on the *outside* of the tubes. If freezing should compress a tube, causing a "set" and so restricting air flow, passing a rod through it restores it to normal shape.

IF WOUNDED THEY QUICKLY FLY AGAIN. Pictures below show how to replace Winchester Cartridge Core Tubes should they be punctured in action or by accident. They explain, too, why millions of Winchester Cartridge Core Tubes are used to keep planes, and tanks in constant action.

HARDER JOBS WANTED FOR THESE SENSATIONAL TUBES

No War Baby, Winchester Cartridge Core Tubes have 25 years of service behind their performance. They offer these spectacular features:

Of pure copper, thus corrosion-proof • Seamless,—safe against leaks • Coolant on *outside* —no damage from freezing • 1,728 cartridge core tubes per square foot • Avoid waste space in radiator assembly—minimum of solder • Permit tailoring radiator to fit any dimension or design • Provide up to 25% greater cooling per square foot than others.

WINCHESTER REPEATING ARMS COMPANY
New Haven, Connecticut
Division of WESTERN CARTRIDGE COMPANY

WINCHESTER
TRADE MARK
"On Guard for America Since 1866"

If out of your engineering knowledge, experience, research and skill you are contemplating a new fighting machine for Uncle Sam . . . are dreaming up a startling new post-war automobile, or similar product, write Radiator Division, Winchester Repeating Arms Company, New Haven, Connecticut.

DAMAGED TUBES ARE PUSHED OUT — NEW TUBES ARE INSERTED — SOLDERING COMPLETES REPAIR

COPR., 1943, WINCHESTER REPEATING ARMS CO., DIV. OF WESTERN CARTRIDGE CO.

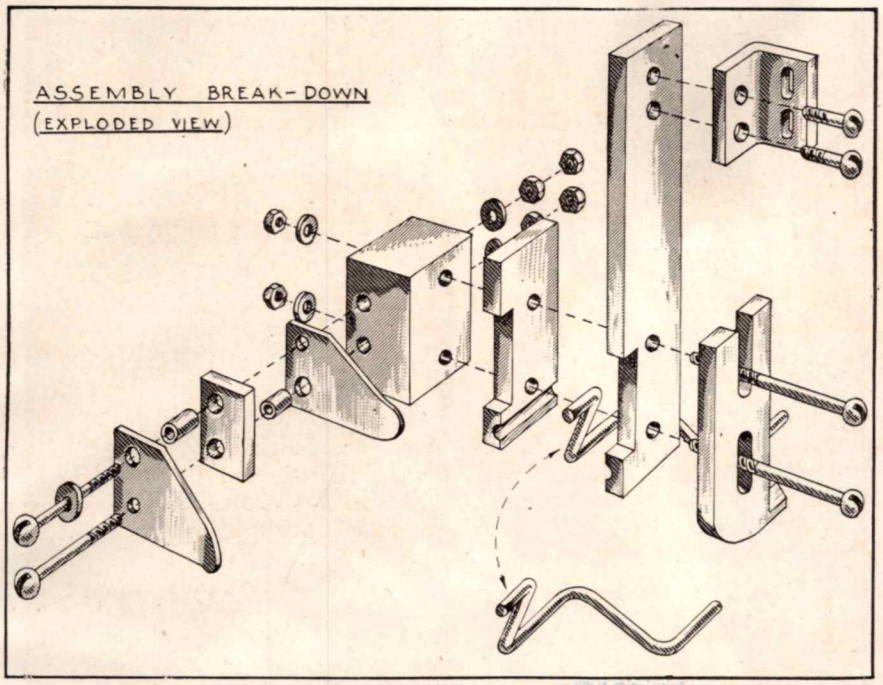


Fig. 3, above: new style three-dimensional "visual" giving exploded view of same part shown in figs. 1 and 2, for assembly breakdown

(*Continued from page* 205)

entails a lowering of costs, both by the reduction of man-hours required for an operation and by cutting down the number of rejects.

Formerly the only way to produce three-dimensional visuals was by means of wash drawings. These drawings never could be wholly satisfactory, because not only are they laborious to make, but they lack the clarity of detail, contrast and accuracy so absolutely essential for use by workers on the production line. With the advent of specially adapted drawing papers, all the objections to wash drawings were instantly removed. The artist can produce on this paper pen and ink drawings that are purely mechanical in their nature yet show the object in its true perspective with full depth and roundness, figs. 4 and 5. These features are essential where drawings are to be used by unskilled or semi-skilled workers. The shadings required to furnish the proper three-dimensional effect are produced by the use of developers applied by the artist to bring out the shaded areas. A different developer is used to bring out each type of shading.

Hand shaded three-dimensional drawings have been used for many years. Their use, however, has been limited as a result of the excessive time required for making them, and their consequent high cost. Not only is hand shading a notorious time waster, but also it is extremely difficult to make all shading lines exactly alike. In addition there is the ever-present likeli-

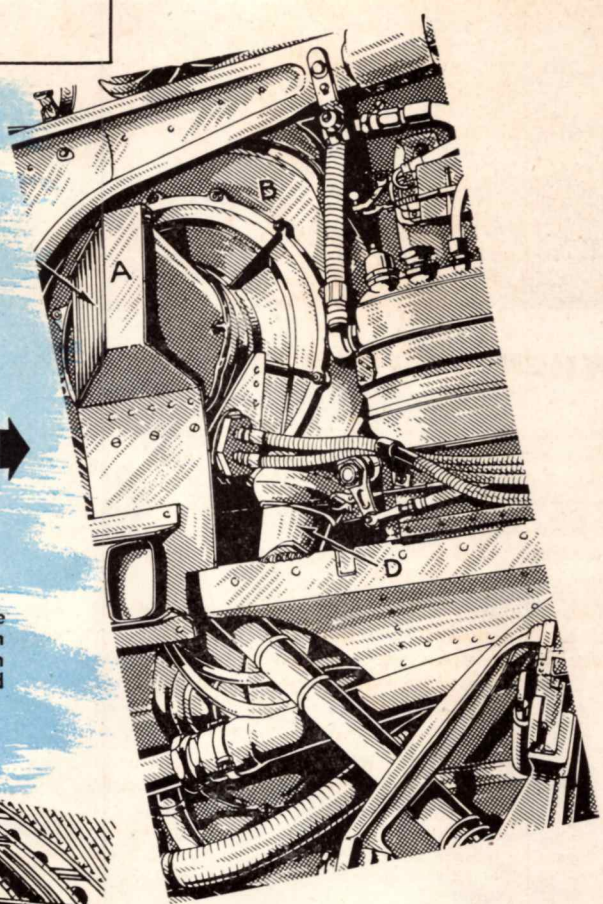
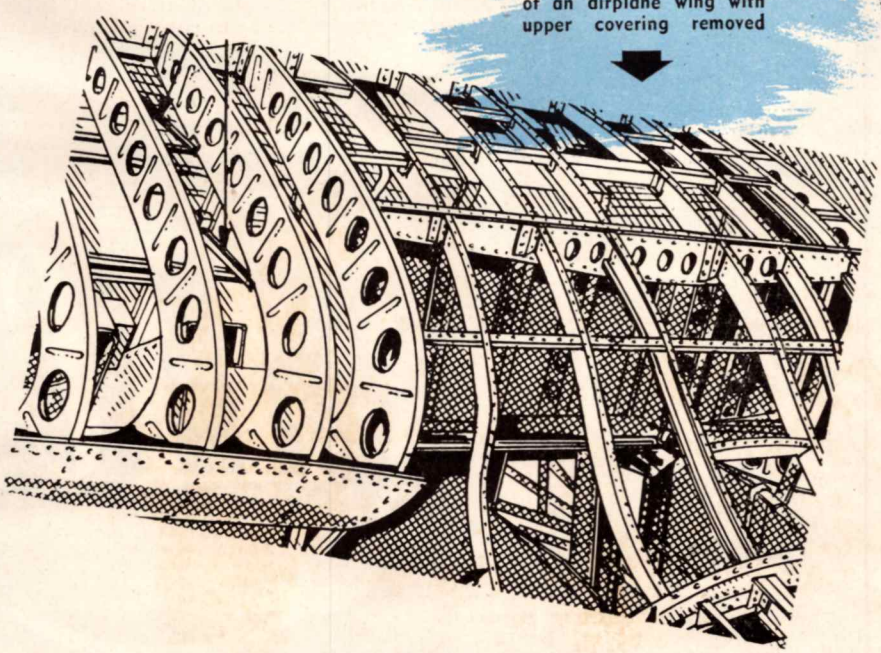


Fig. 4, right: Perspective drawing, showing section of messerschmitt engine in detail

Fig. 5, below: Perspective drawing of upper section of an airplane wing with upper covering removed



hood of smearing the lines, with consequent damage to the appearance of the drawing.

Drawing papers are now available which eliminate the laborious and expensive hand shading. The lines are perfect and identical and the finished appearance of the drawings is much superior to hand shading. The various shading patterns and tones are brought out in these special papers through the use of developers—applied with a brush to the areas to be shaded. It is

(*Continued on page* 267)

NUMBER TWO IN A SERIES OF ADVERTISEMENTS DEVOTED TO THE SAFETY FACTOR IN AIRCRAF

BLUEPRINTS OF SAFETY

"They copied all they could follow, but they couldn't copy my mind."

KIPLING

AAC Products

AIRCRAFT ACCESSORIES CORPORATION

MANUFACTURERS OF

PRECISION AIRCRAFT EQUIPMENT

HYDRAULICS . . . . . ELECTRONICS

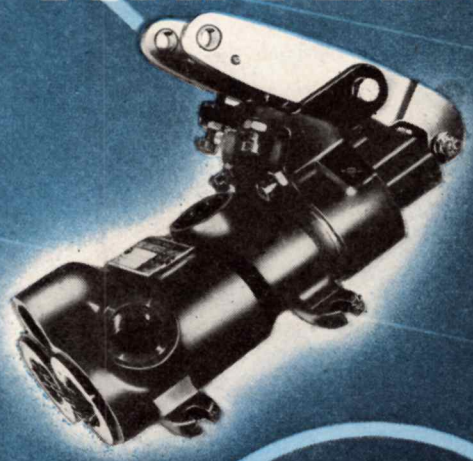
BURBANK, CALIF. • KANSAS CITY, KANS. • NEW YORK, N. Y. • CABLE ADDRESS: AACPRO

Randolph C. Walker PRES.

BLUEPRINTS OF SAFETY

ARMY (E) NAVY

STARS OVER THE AXIS



Aptly named is this glorious Lockheed... Constellation! For as cargo carrier, or troop ship, it's bad news for the Herrenvolk . . . whichever load she delivers. Ability to get off easily and set down safely, often with tricky terrain, is largely due to precision hydraulic units which give superb control of this big one. . . . "Blueprints of Safety" guide A. A. C. methods of manufacturing brake control valves, which insure maximum dependability and performance. . . . . .

HYDRAULICS DIVISION

AAC Products

AIRCRAFT ACCESSORIES CORPORATION

MANUFACTURERS OF

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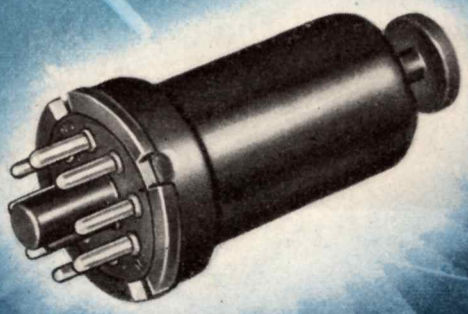
Rudolph E. Walker PRES.

BLUEPRINTS OF SAFETY

TANKS...A MILLION

No slang intended, men, but we're told that's the way it looked . . . when the Shermans started rolling Rommel in reverse. Today . . . headlines emphasize the increasingly effective job that our mechanized units are doing over the entire invasion front . . . And since, in the roar and din of mechanized battle, quartz crystals are the one method for keeping harried Commanders tuned to prearranged frequencies, so vital for clear transmission . . . for accurate co-ordination . . . A. A. C. methods of manufacturing are of vital importance. Our "Blueprints of Safety" demand that A. A. C. crystals be matched to guard the invisible tolerance. . . . . .



ELECTRONICS DIVISION

AIRCRAFT ACCESSORIES CORPORATION

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PRECISION AIRCRAFT EQUIPMENT
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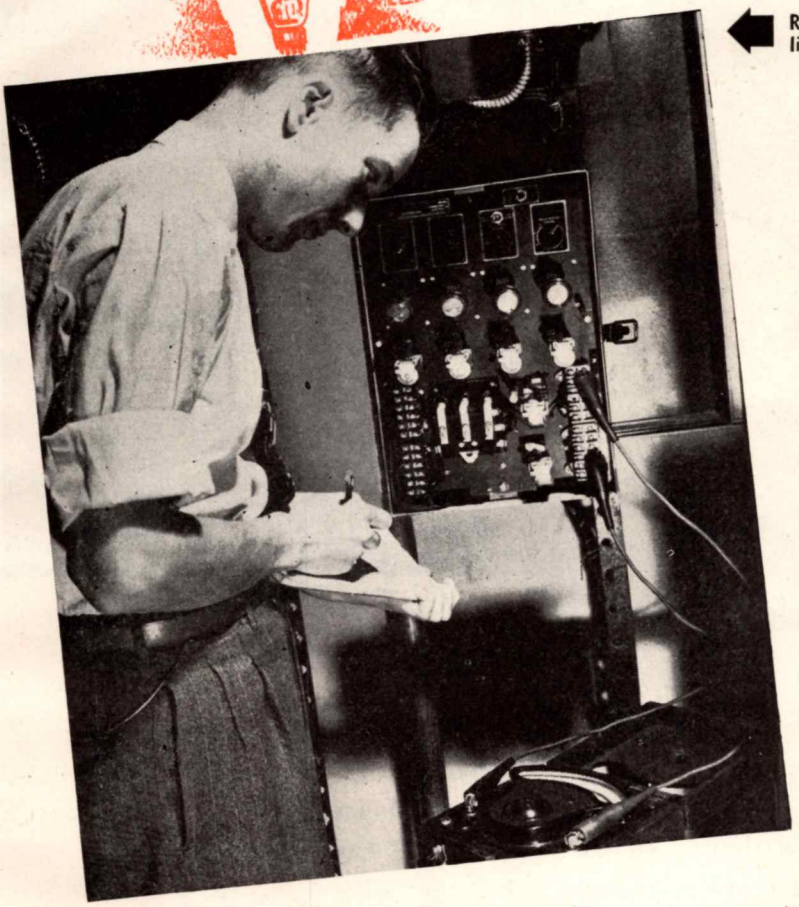
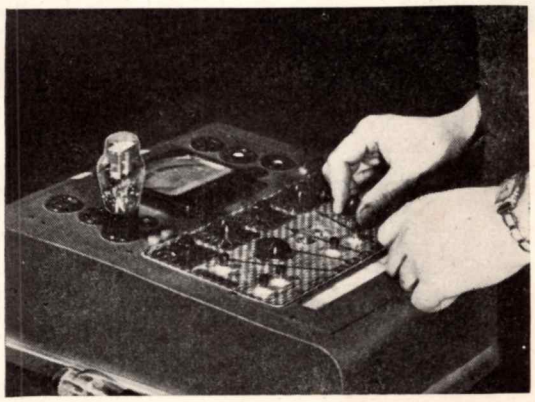
MAINTENANCE OF ELECTRONIC CONTROL DEVICES

W. D. COCKRELL

Engineer, Electronics Section,
Industrial Control Division,
General Electric Co.



Routine checking for variations between line voltage and nameplate rating



Wave shape faults are turned up by the cathode-ray oscilloscope

● Electronic control devices ranging from specialized resistance welding controls used in metal-working industries to standard photoelectric relays (electric eyes) used for hundreds of jobs in all industries are being worked hard in today's production battle. As a rule, the equipment for these devices requires less maintenance than does other electrical equipment because it has no moving or wearing parts. Nevertheless, to keep it in top-notch operating condition and to prevent production interruptions, it is essential that certain maintenance procedures and checks be followed and that troubles be located and remedied as quickly as possible.

Most of the components of electronic controls, such as resistors, reactors, transformers, and capacitors, are of a semipermanent nature, conservatively rated to give many years of service with very little maintenance. The electron tubes themselves though replaceable, require inspection and test only at comparatively long intervals.

These circumstances, and the fact that electronic controls sometimes continue to function under extreme conditions of moisture, temperature, and dirt, frequently encourage a tendency to neglect the simple rules of good maintenance. To insure good maintenance, it is advisable to remember that many parts of electronic controls are similar to those used in magnetic controls: enclosing cases, bases, terminals, wiring, and conduit devices often are identical. Standard magnetic control devices, such as fuses, switches and overload relays of both the instantaneous and the time-delay types, are found on many electronic panels.

These devices usually perform starting or protective functions and operate infrequently. But even infrequent operation of standard magnetic control panels sometimes causes special maintenance problems. Detailed instructions for their inspection and maintenance may be found in maintenance manuals which cover these standard devices.

Special emphasis should be placed on inspection for cleanliness and the effects of vibration. Because of the high impedances used in some electronic circuits, an excessive accumulation of dust or processed material, particularly when damp, will provide parasite circuits which may interfere with proper operation. Lenses and other parts of optical systems should be frequently wiped off with a clean, soft rag.

Since many electronic panels are

(*Continued on page* 213)

PORUS ★ KROME

IS A COUSIN TO *Phylum Porifera*

Phylum Porifera is the marine animal that deposits sponges in the sea. Sponges are porous. Hold liquids.

PORUS-KROME is the process that deposits a very particular kind of chromium on bearing surfaces. It, too, is porous. Holds oil.

When chromium is applied to cylinder bores by the PORUS-KROME process, it provides an extremely hard-wearing surface filled with minute oil reservoirs. This assures vastly improved lubrication, reduces wear on the cylinder, rings and ring grooves. Oil consumption is held constant. Power and efficiency are maintained at high levels. Engine overhaul is reduced.

These are the big reasons why PORUS-KROME is being used on an ever-increasing number of internal combustion engines for aircraft, motor ships, tanks and other piston-activated equipment. The reasons are explained more fully in our newest literature. Write for it.

VAN DER HORST TRADE MARK

PORUS ☆ KROME

Multiplies Engine Life

VAN DER HORST CORPORATION OF AMERICA CLEVELAND, O. OLEAN, N. Y.

(*Continued from page* 211)
extensively interconnected with other apparatus, the loosening of connections or the breakage of leads through the effects of vibration may cause serious shutdowns, entailing an intensive search before the fault is located. Vibration also tends to shorten tube life. When there is severe vibration at the installation location, shock mounting of the control panels, as well as the use of stranded or extra-flexible leads, may be justified.

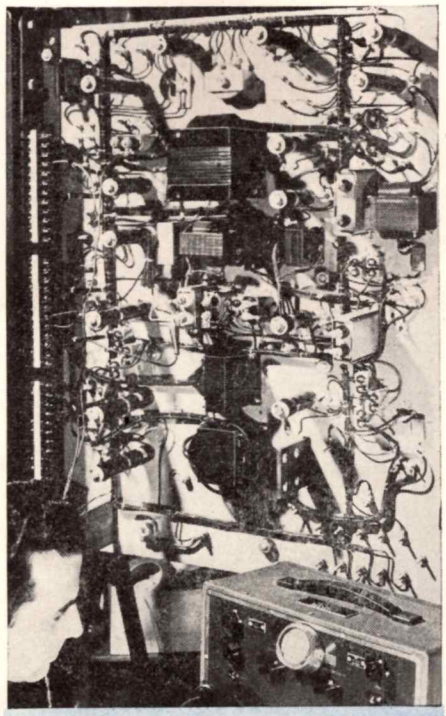
Shocks and Jars Damage Tubes

Shocks and jars in handling tubes, particularly when they are old, can be quite detrimental too. Sharp shocks, as those caused by dropping or striking the tube, if they do not actually rupture the envelope, may jar the elements out of position or even break welds or leads.

Photoelectric and other electronic controls involving mechanical components should be checked frequently to assure that the mechanical adjustments have not been disturbed. Loosening of bolts due to vibration or to chain hoists or other shop equipment hitting against the equipment, are the most common causes of such disturbances.

Rarely does a modern electronic tube fail suddenly. Usually the failure is the result of a gradual loss of emission that takes place as the active cathode material is used up or flakes off. Overloading, mechanical abuse, operation at high or low filament or cathode-heater voltage, and operation outside of required temperature limits, all tend to shorten tube life.

Among the most prevalent causes of poor operation and short tube life are the operation of electronic panels on line voltages differing too greatly from the panel nameplate voltage, and the use of the wrong tap when a tapped-input transformer is provided. Usually, panels are designed to operate satisfactorily on line voltages varying plus or minus 5% of the panel rating. If the voltage at the installation point is consistently high or low, a small auto- or booster-transformer may be used. If the line voltage fluctuates widely, a special voltage-regulating transformer may be required. Faulty heater transformers, loose connections and corroded sockets may limit the low-voltage, high-current power required for the tube cathode heater.



Tubes in electronic control apparatus should be tested often and replaced when defective

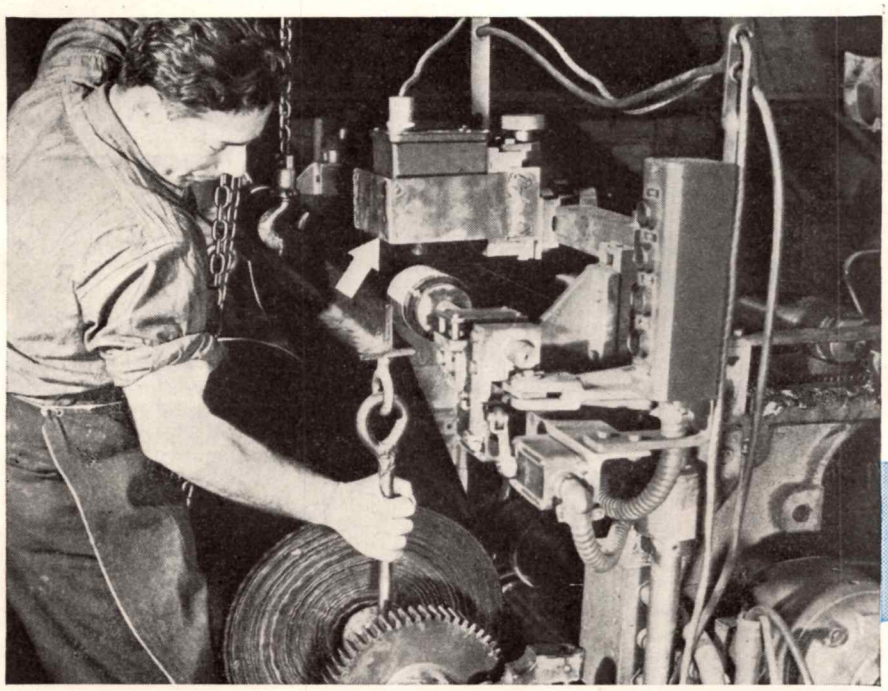
High-vacuum tubes and tubes filled with true gases, such as argon and xenon, may be operated without difficulty over a wide ambient temperature range; but tubes containing mercury vapor operate best in a more restricted ambient range. Enclosing case ventilation and other temperature-regulating means are provided for the usual industrial indoor ambient temperatures of 60° to 100° F. For low ambient temperatures, manually or thermostatically controlled strip heaters may be mounted in the case. For temperatures from 100° to 120° F, fan or forced-air cooling may be sufficient. Above this temperature, components other than the tubes may be affected, and standard equipment is likely to be unsuitable for the installation.

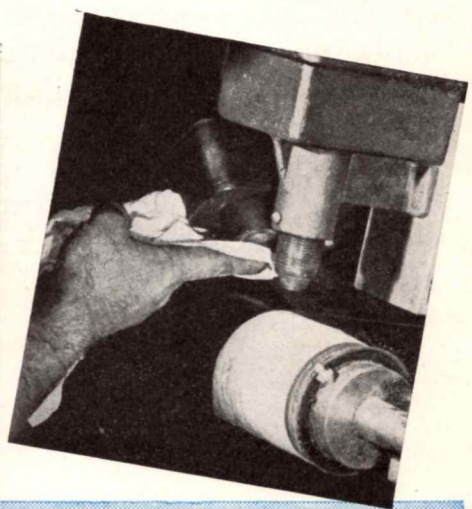
Protective Timer

Panels which use gas- or mercury-filled tubes are normally equipped with a cathode protective timer. This timer is set for the heating period prescribed by the instructions that come with each new tube. Experience has proved that this is the minimum time permissible for reasonable tube life and that it must not be decreased for any reason.

During the shipment or handling of mercury-vapor-type tubes, the liquid mercury may be splashed on the elements. Hence, when the tube is first placed in service, it will be necessary to heat the tube cathode with the anode lead disconnected, until the splashed

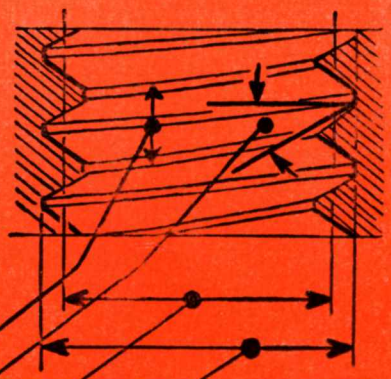
(*Continued on page* 282)





Left: Arrow points to guard protecting scanning head from chain hoist or workmen's tools. Above: Soft, clean rag should be used in cleaning of lenses of photoelectric optical systems

Check these quickly, accurately . .



WITH

VARD THREADED PLUG GAGES

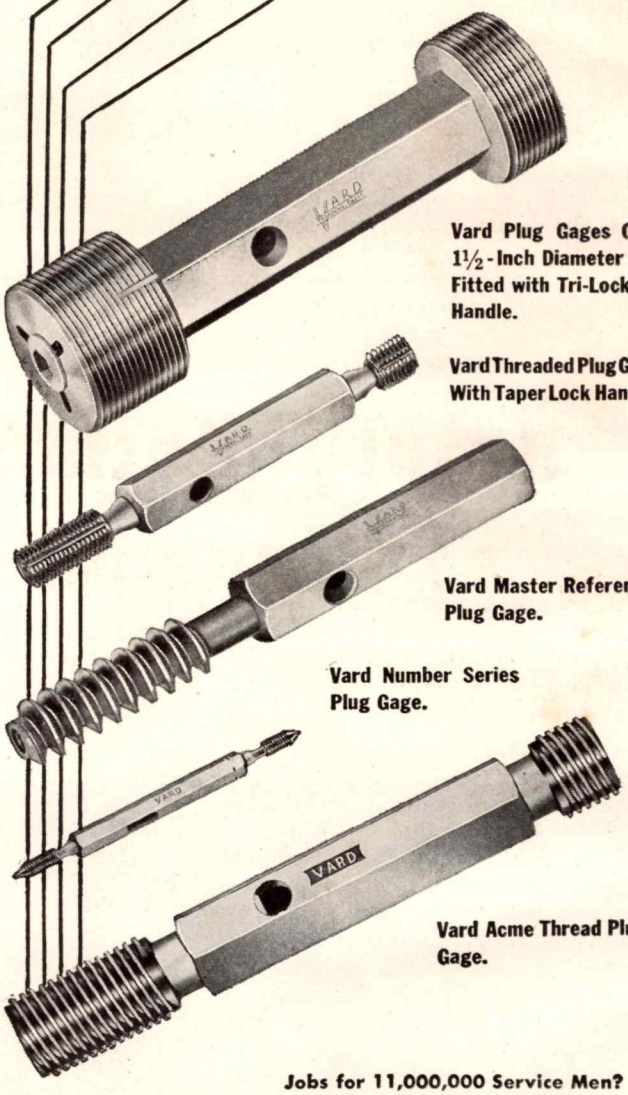
Now is the time for greatest war effort. Cut down on your rejections and speed production by use of VARD threaded plug gages.

Use these accurate, long wearing, working gages to quickly inspect internal threads. Use VARD master reference gages to check wear on your ring gages.

VARD threaded plug gages are made in gage sizes from No. O-80 NF. to 12″ diameter, and in NC., NF., NS., Metric, Acme and special pitches, in both right and left hand threads.

VARD plug gages are ground from special-alloy, long wearing steel, and are hand finished and inspected with the most modern and exact mechanical and optical equipment.

They may be ordered as complete units consisting of a "GO" member, a "NO GO" member, and a handle, or any member may be obtained separately.



Vard Plug Gages Over 1½-Inch Diameter are Fitted with Tri-Lock Handle.

Vard Threaded Plug Gage With Taper Lock Handle.

Vard Master Reference Plug Gage.

Vard Number Series Plug Gage.

Vard Acme Thread Plug Gage.

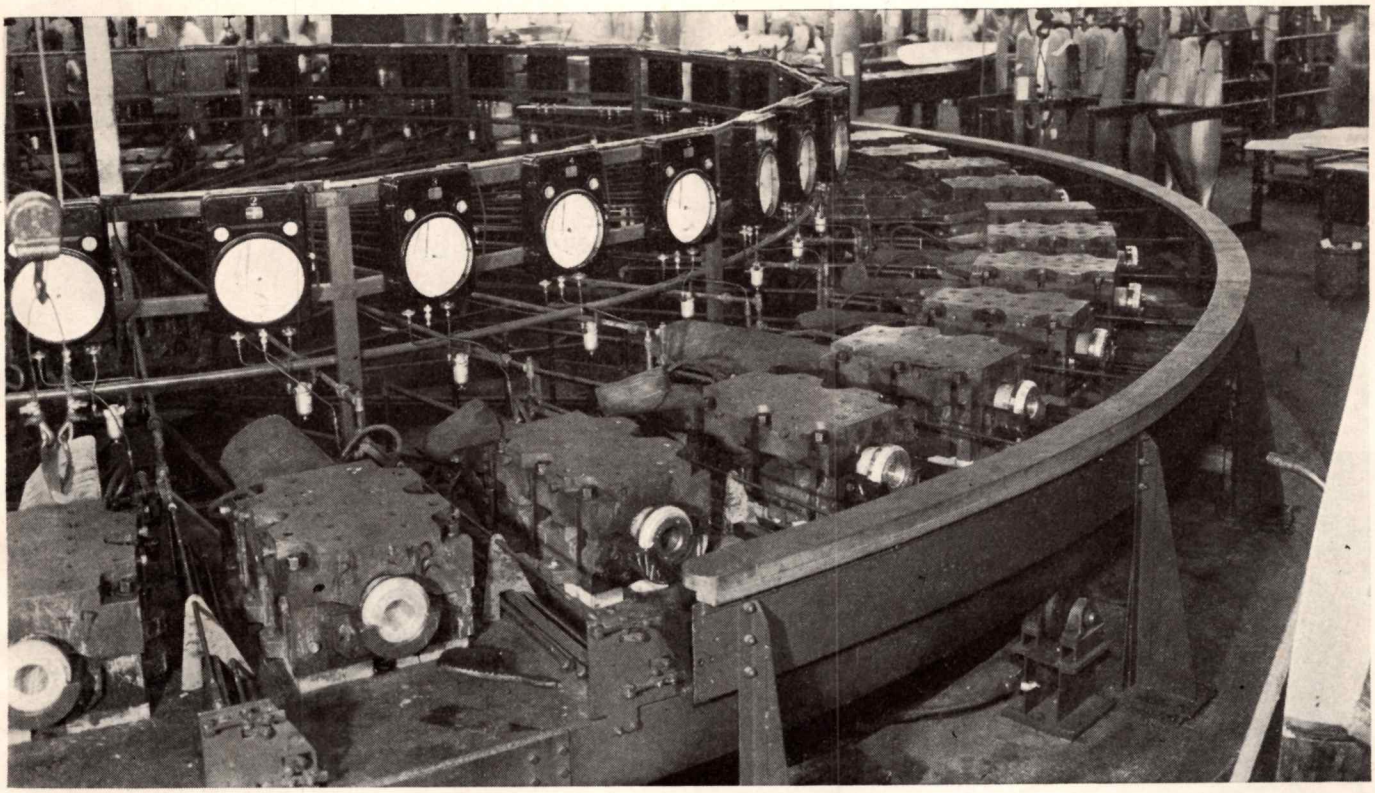
Jobs for 11,000,000 Service Men?

Some day, maybe soon, men will pour out of the Army — looking for work. Can plants now loaded for war, switch in mid-air and produce for peace? Not unless they have CASH — accumulated to carry over the transition and pay wages. American war industry must be allowed to *Hold Some Profits in Reserve* — in Trust for those 11,000,000 Jobs.

VARD INC.

Thread & Plug Gages • Snap Gages • Plain Tapered Ring Gages • Bench Model External Comparators • Dividing Machines • Precision Ground Optical Lenses & Filters • High Fidelity Mirrors

PASADENA, CALIFORNIA



Propeller blades on the 42-ft diameter rotary curing machine progress clockwise through a cooling cycle to the unloading station

Rotary Machine Speeds Curing of Propeller Blade Fairings

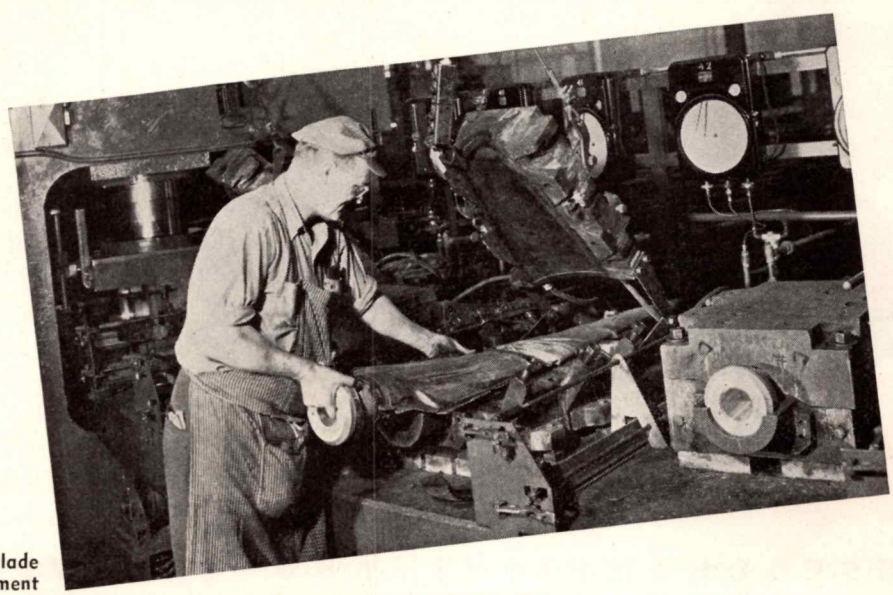
● A huge steel turntable in the East Hartford, Conn. plant of Hamilton Standard Propellers has broken a production bottle-neck in blade fairing manufacture. This 100-ton rotary curing machine, so far as is known, is unique both in conception and in design.

The turntable, which is 40 ft in diameter, turns on rollers mounted on a concrete foundation. The outer rim of the table is flat and is divided into forty-two separate slots, each of which is a sector carrying a half-ton mold into which the blade fairing assembly is inserted for curing. Each slot has its individual system of air, steam, water and electricity, automatically controlled through cam-operated valves and Bristol pressure controllers. Main supply lines are brought in through the center of the turntable by swing joints and slip rings.

The machine cures two sets of twenty-one blades simultaneously. Each mold starts at a loading station, turns to a gap-type hydraulic press, then moves successively through a steam heating cycle, a water cooling cycle, and finally to an unloading station half-way around the circle. At the last point a similar cycle is started and repeated on the other half-circle.

The machine turns intermittently clockwise, advancing one blade sector every 12 min, activated by a pneumatic ratchet drive from a 14-in air cylinder connected to the shop's regular compressed air lines. This movement al-

(*Continued on page* 280)

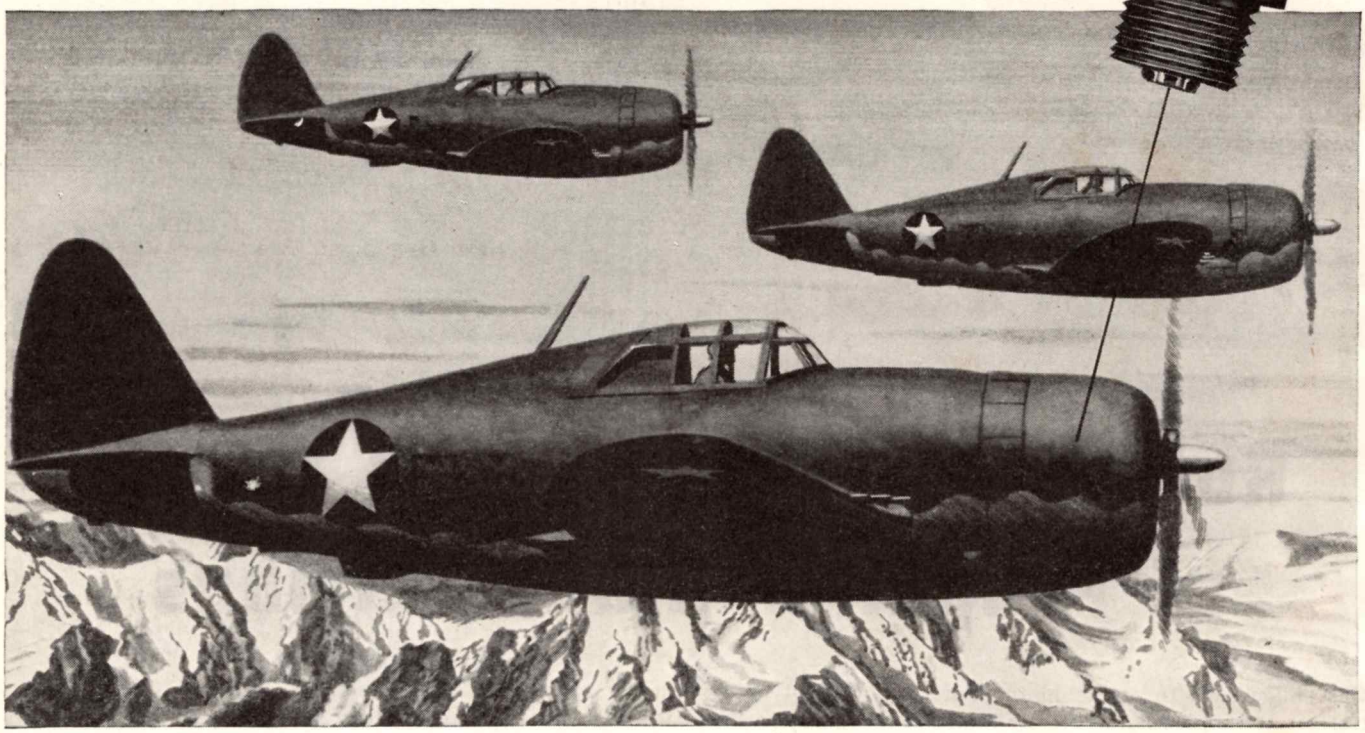


Unloading a faired propeller blade after four-hours curing treatment

CHAMPION SPARK PLUGS

in today's high output, turbo supercharged engines take a lot of punishment. The same qualities that made Champion the spark plug of racing champions have skyrocketed them to favor for our most powerful aircraft engines.

C26S—Shielded



C26—Unshielded

Just as no chain is stronger than its weakest link, so no spark plug is better than its insulator.

The insulating material used in Champion Ceramic Aircraft Spark Plugs is a revolutionary, new development, having properties and advantages unequalled by any other insulating material.

Its resistance to heat and mechanical shock —wide variation in temperature and pressures—make it ideally adapted to the manifold ignition problems encountered in high altitude flight.

In addition, Champion Ceramic Aircraft Spark Plugs are backed by thirty-odd years of experience in the spark plug field exclusively—a certain "know how" that is evidenced by their outstanding dependability with our air forces.

Characteristic advantages of Champion Ceramic insulation are:

1. Immunity from heat and chemical reactions.
2. Freedom from fuel, oil, or moisture absorption which causes "shorts".
3. Inherently high heat conductivity with consequent wider range between pre-ignition and fouling.
4. Absolute uniformity of material.
5. Homogeneous structure eliminates air spaces which cause current leakage.
6. Easily cleaned and serviced—no specialized equipment or factory returns necessary.
7. Scientifically controlled manufacture.

USE CHAMPIONS AND FLY WITH CONFIDENCE

AIR CONDITIONING Helps Production in Many Ways

L. W. CLIFFORD

Air Conditioning Division,
Westinghouse Electric & Manufacturing Co.

● Air conditioning and refrigeration are helping the aviation industry win the war by maintaining correct temperatures, by controlling relative humidity and by ridding production areas of air-borne dust. The more important applications are to be found in machine shops, gage testing rooms, electroplating and anodizing departments, welding departments, dope drying rooms, armament inspection rooms, pilot training centers, stratosphere testing chambers, parachute inspection and testing rooms, pilot flying equipment storage, and in the protection of critical instruments.

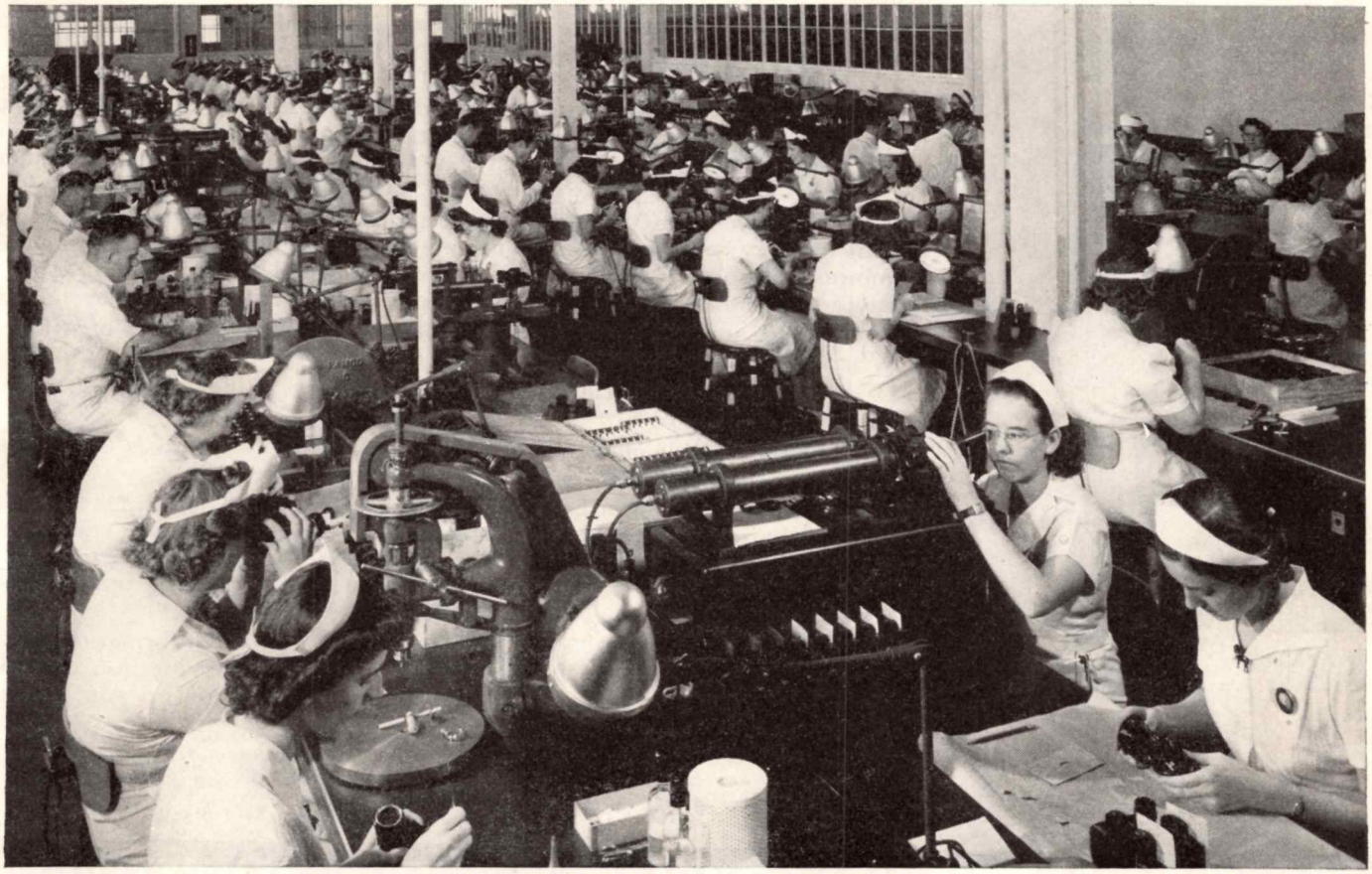
In gage rooms, temperature and relative humidity must be held to prescribed levels (68° F and 50% respectively) to prevent variations in the degree of accuracy of master gages and to avoid damage caused by excessive moisture. Air conditioning provides such control automatically.

Again, temperatures of cooling baths used in electroplating and anodizing are controlled by refrigerating units. The requirements vary according to the metal being handled and the kind of plating used. To maintain uniformity in the plating thickness, temperature fluctuations must be kept within a narrow range.

Metallurgical analysis by use of the spectroscope must be carried on in rooms where temperature and humidity are constantly controlled. Air conditioning keeps lenses free from dust and lint and minimizes perspiration on the part of those who handle

(*Continued on page* 219)

Binoculars and equipment are kept free from dust and lint in workshop regulated by air conditioning and electric air cleaners



Precise Load Rating OF LORD BONDED RUBBER MOUNTINGS

RESULTS IN HIGH EFFICIENCY OF VIBRATION ISOLATION

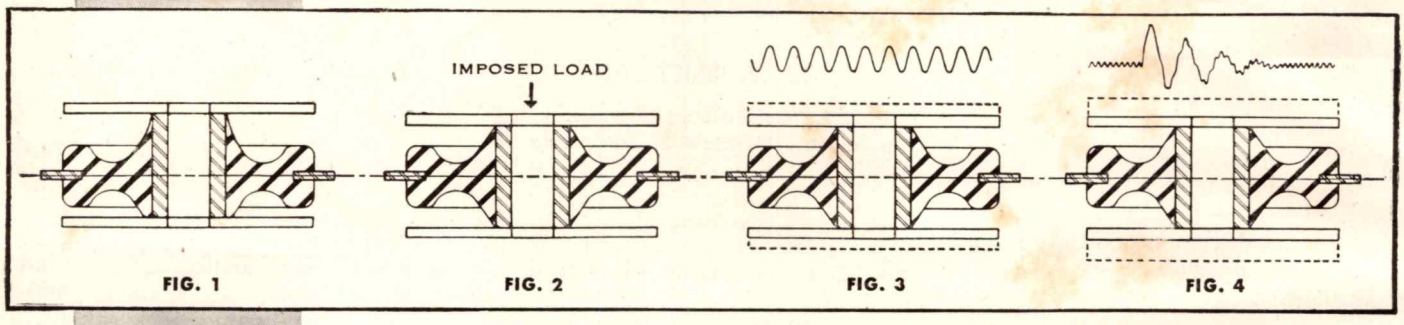


FIG. 1 FIG. 2 FIG. 3 FIG. 4

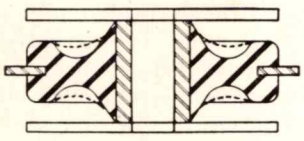


FIG. 5

Operation of Plate Form Mountings

ALL Lord Mountings are designed to operate on the principle of having the rubber "stressed in shear" when load is applied in the direction of the main axis of the mounting. This mounting design provides the required softness and deflection in the direction of the disturbing forces, and stability or resistance to movement in directions normal to the major thrusts, thereby obtaining the highest degree of vibration isolation efficiency.

The proper deflection of a mounting under a given static load is of paramount importance in selecting a suitable means of flexible suspension, and every Lord Mounting is designed to have a definite static deflection under its rated load. Lord Plate Form Mountings (non-snubbing type) are designed to deflect 1/16 inch when rated load is applied.

Illustrations above show a Lord Plate Form Mounting in the various positions it assumes while static or in action:

Fig. 1—Under no load (as shipped from factory). Note extension of center sleeve. Fig. 2—Under rated load; note that center sleeve has deflected 1/16 inch. Fig. 3—Operating in zone of free shear action under normal vibration. Fig. 4—Operating momentarily under sudden shock or in zone of resonance. *(see footnote)

Lord Plate Form Mountings are designed to cover a wide range of applications in every field of industry. They are made in four shapes (round, square, diamond, and holder types) and four sizes, with load ratings ranging from a few ounces to 300 pounds. Load ratings of each size can be varied by:

1—Utilizing different rubber compounds of varying degrees of stiffness to meet specific spring-rate requirements.

2—Changing dimensions of rubber element at flexing point. (See Illustration No. 5)

The remarkable efficiency of Lord Plate Form Mountings is due to the accuracy, precision, and uniform quality of manufacture.

Various factors must be considered when choosing mountings for individual installations. Through proper mounting selection, isolation efficiencies ranging from 75% to 85% reduction of disturbing forces may be expected, although reductions up to 97% are not unusual on equipment operating at very high frequency.

Write for bulletins 103 and 104. They give complete information on all Lord Mountings as well as an engineering discussion on vibration control. Better still, call in a Lord vibration engineer for consultation on your design problems. There is no obligation.

**Where frequent shock loads or operation in resonance zone are encountered, the use of Lord Vertical Snubbing Type Mountings is recommended. See Bulletin 103.*

INVEST TODAY IN BONDS FOR VICTORY

LORD MANUFACTURING COMPANY . . . ERIE, PENNSYLVANIA

Originators of Shear Type Bonded Rubber Mountings

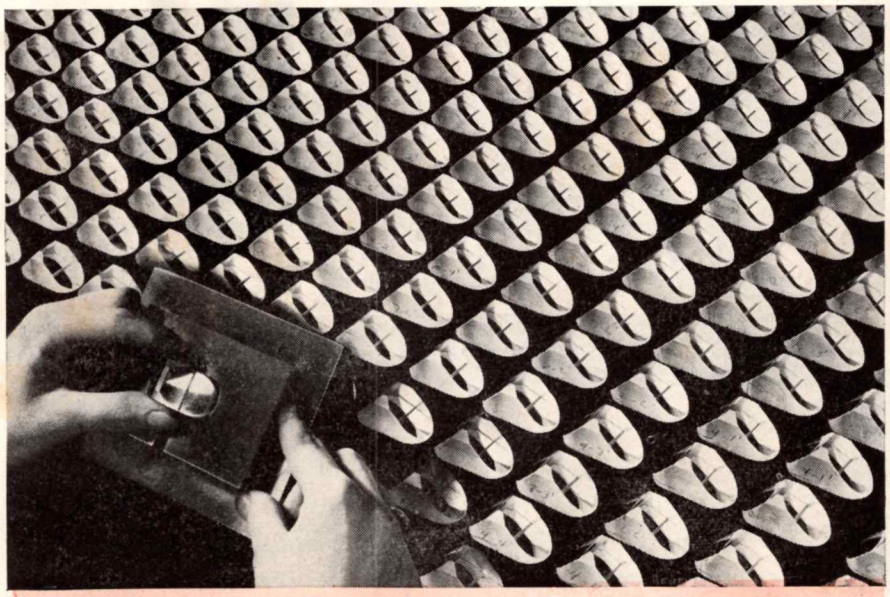
SALES REPRESENTATIVES · NEW YORK, 280 Madison Ave. · CHICAGO, 520 N. Michigan Ave. · DETROIT, 7310 Woodward Ave. · BURBANK, CAL., 245 E. Olive Ave.

(*Continued from page* 217)

these delicate instruments—an important consideration in keeping them free of moisture. Close control of the room temperature also assures a fixed optical focus and keeps emulsified plates from deteriorating.

Tips used in spot welding give more welds between cleanings when they are chilled. Refrigerated water may be employed, or the refrigerant itself may be circulated through the tips. In the latter case, temperatures of 0° F and colder now are the rule. Better welds result, too, due to a lessening in the amount of metal "pick-up" and in the frequency with which mushrooming of tips occurs.

The air conditioning of dope and drying rooms where dope is applied to propeller, fuselage and wing parts, speeds the drying, prevents blushing of the dope during drying and helps, to obtain a good permanent finish.



Glass prisms, vital parts in the optical system of a war device, are checked to one-half the thickness of a human hair in air conditioned rooms

Rivet Storage

Storing of aluminum rivets, after fabrication, in cabinets held at sub-zero temperature levels, keeps them soft so that they will head-over without fracture. Smaller low-temperature cabinets are used for carrying the rivets from storage to the point in the plant where they are to be used.

At air bases where high temperatures prevent protracted periods of pilot training, air conditioning is used, especially in connection with Link trainer activities where the cockpit heat is lowered to a point of greater human efficiency; this protects the instruments.

Stratosphere conditions, which must be simulated in the training of pilots, can be created by artificial methods in special air-conditioned chambers where the temperature, humidity and air pressure are raised and lowered at will. For certain types of studies the chambers are so designed that both temperature and pressure can be reduced simultaneously to simulate conditions at any altitude up to 40,000 ft.

Due to the tendency of fabrics to absorb moisture from the air, parachute material as well as the fabricated product must be tested under specified atmospheric conditions before being accepted by the government. Air-conditioned laboratories are used for this purpose.

Flying suits of all of the military forces are stored in air-conditioned rooms. At temperatures below 40° F, moth larvae become dormant and at 20° F they are usually killed. During the storage period the "shock" system of moth killing is done by quickly raising the temperature to 50° F where it is held for a few hours and then suddenly dropped to 15° F. The higher temperature causes dormant larvae to become reanimated and the drop to 15° usually kills them.

Control towers at air fields are air conditioned because they are exposed to the sun. Without temperature control, tower rooms would be unbearable. Besides, the heat and dust might damage critical instruments.

Steps in determination of composition of a substance by spectrographic analysis Characteristic wave-lengths of elements reveal their presence. Conditioned air is highly essential to this work

Control Problems Wanted!

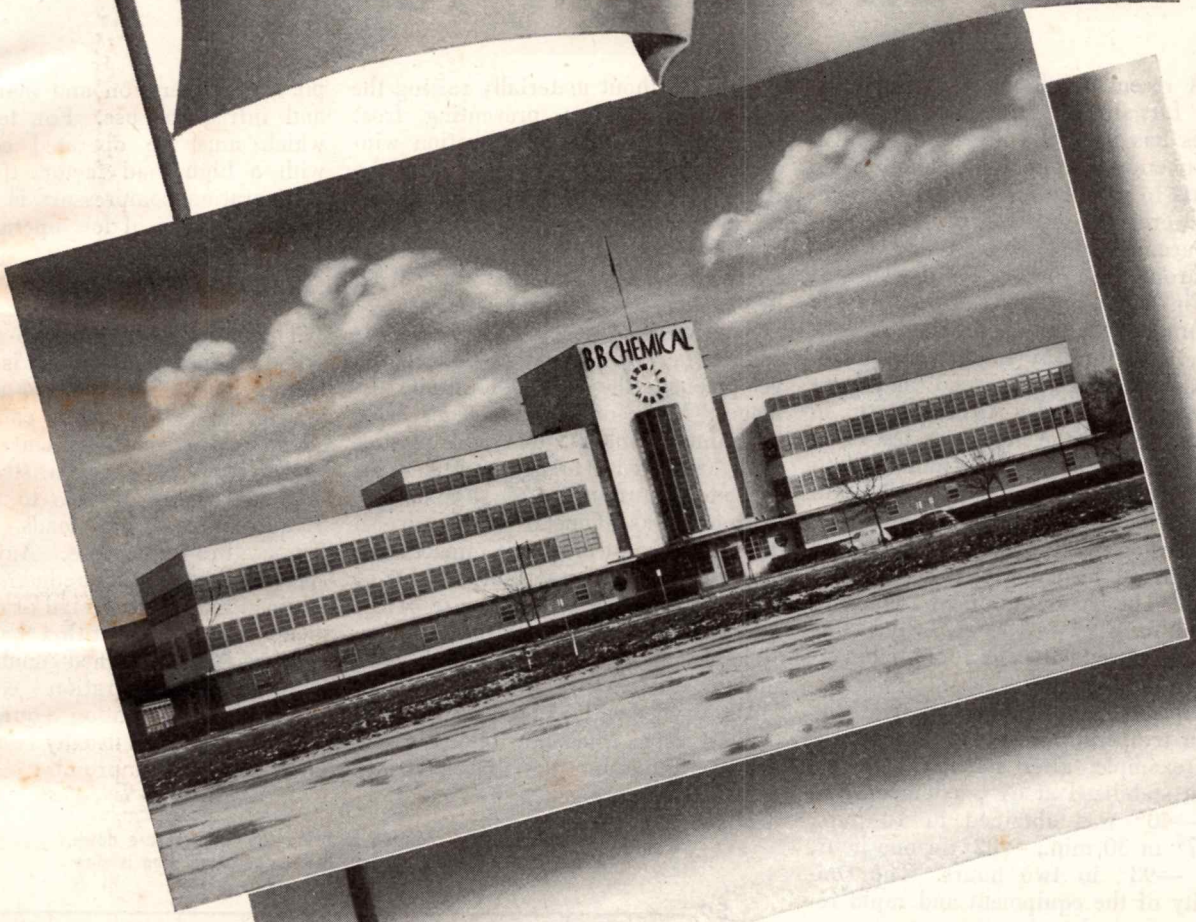
IN cooperation with the technical agencies of our armed services and those of the United Nations, as well as many aircraft manufacturers, Minneapolis-Honeywell engineers have developed and are producing a number of important new "Aids to Aviation." The nature of these contributions obviously cannot be revealed for reason of military security, but M-H Aeronautical Controls and equipment are in daily use in every war theater. Pre-peace planning, however, is another story. When the time comes, Minneapolis-Honeywell will be ready for peacetime aeronautical problems. We therefore invite your future control problems on the basis that we have proved both our engineering and our manufacturing ability and can obviously help you with your future plans . . . Minneapolis-Honeywell Regulator Co., Aeronautical Division, 2791 Fourth Ave. S., Minneapolis, Minn.

MINNEAPOLIS-HONEYWELL

AERONAUTICAL INSTRUMENTS

AERONAUTICAL DIVISION

ADHESIVES..



● The building pictured above is indeed a fine setting for the most up-to-date equipment used in chemical research, and for the busy laboratories contained therein which are staffed with men who, through years of experience, know how to make the best possible adhesives, either from natural raw materials or synthetic rubbers. It is no wonder, therefore, that the B. B. Chemical Co. is known throughout this country as the place where your most difficult bonding problems can be solved. Be it a small electrical unit or an airplane, be it a jungle hammock or a barrage balloon, if a cement is needed to complete the finished product, the B. B. Chemical Co. *can* be of service.

B. B. CHEMICAL CO. 784 MEMORIAL DRIVE, CAMBRIDGE, MASS.

USE of DRY ICE for TESTING

● A recent development in refrigeration for aircraft laboratory test purposes has been the use of dry ice in conjunction with methyl alcohol. Early efforts to use dry ice without the alcohol were not satisfactory because of the accumulation of frost and water-ice around the dry ice and because of an introduction of carbon dioxide vapors into the test chambers.

In 1941 the Gay Engineering Corp. of Los Angeles, designed and constructed for Douglas Aircraft Corp., in Santa Monica, the first large test-room to be cooled by dry ice immersed in methyl alcohol. The results proved to be satisfactory from all standpoints. The carbon dioxide vapors were vented through an insulated duct to the outdoors. The alcohol attained a constant temperature of —180°F., which was capable of reducing the room temperature to **—98°.**

Rapid temperature reductions of the room temperature were accomplished. For example, after starting with the room stabilized at 67°, a temperature of —40° was obtained in 10 min., —67° in 30 min., —82° in one hour, and —93° in two hours. The simplicity of the equipment and rapid response proved to be of great value to the research engineers who could make several tests per day at alternately warm and cold temperatures.

Testing Rooms

The room measured 11 ft by 14 ft by 8 ft high. Plans are under way to double the size. Many similar rooms have since been built in various parts of the country. Some of these rooms incorporate provisions for testing at temperatures up to 160° by using electric heaters.

Some of the success of the installation can be attributed to the quality of the insulation of the room. Inspection of the walls after two years of operation has shown no impairment of the hermetically sealed walls.

Several minor problems arose in the design of the complete system, such as that of providing for the liberation of gas from the alcohol caused by agitation and heating; defrosting the cooling unit without materially raising the room temperature; preventing frost accumulation on the observation windows; preventing low pressures in the room caused by the lowering of the air temperature, and introducing ventilating air without depositing frost in the rooms. These problems were solved to the satisfaction of the users.

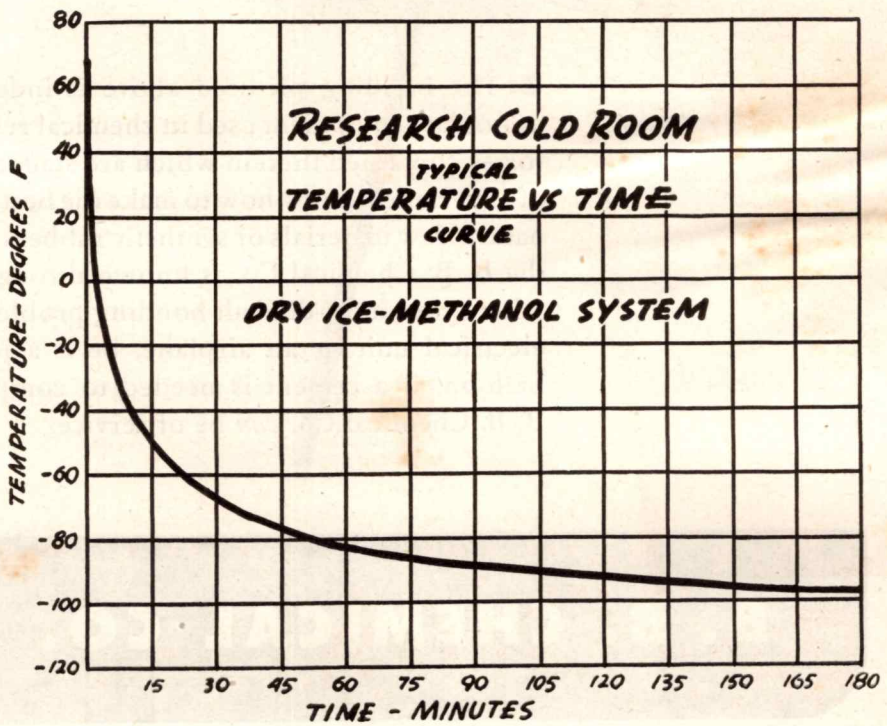
The value of these test chambers cannot be over-estimated in the development of the new high altitude airplanes. Many organic materials, such as paints, rubbers, oils and plastics have been found to be unsuitable for low temperature operation. The change in dimensions of metal parts and also the resistance of metals to impact have been found to be important subjects of research. Another valuable use of the cold rooms has been the investigation of icing conditions on cabin windows and the efficiency of cabin insulation.

The dry-ice-with-alcohol system is of greatest value when the following factors are important: low first cost, simplicity of operation and maintenance, and infrequent use. For test rooms which must be operated constantly, with a high load factor, the use of refrigeration compressors is more desirable because of low operating cost.

Initial Cost

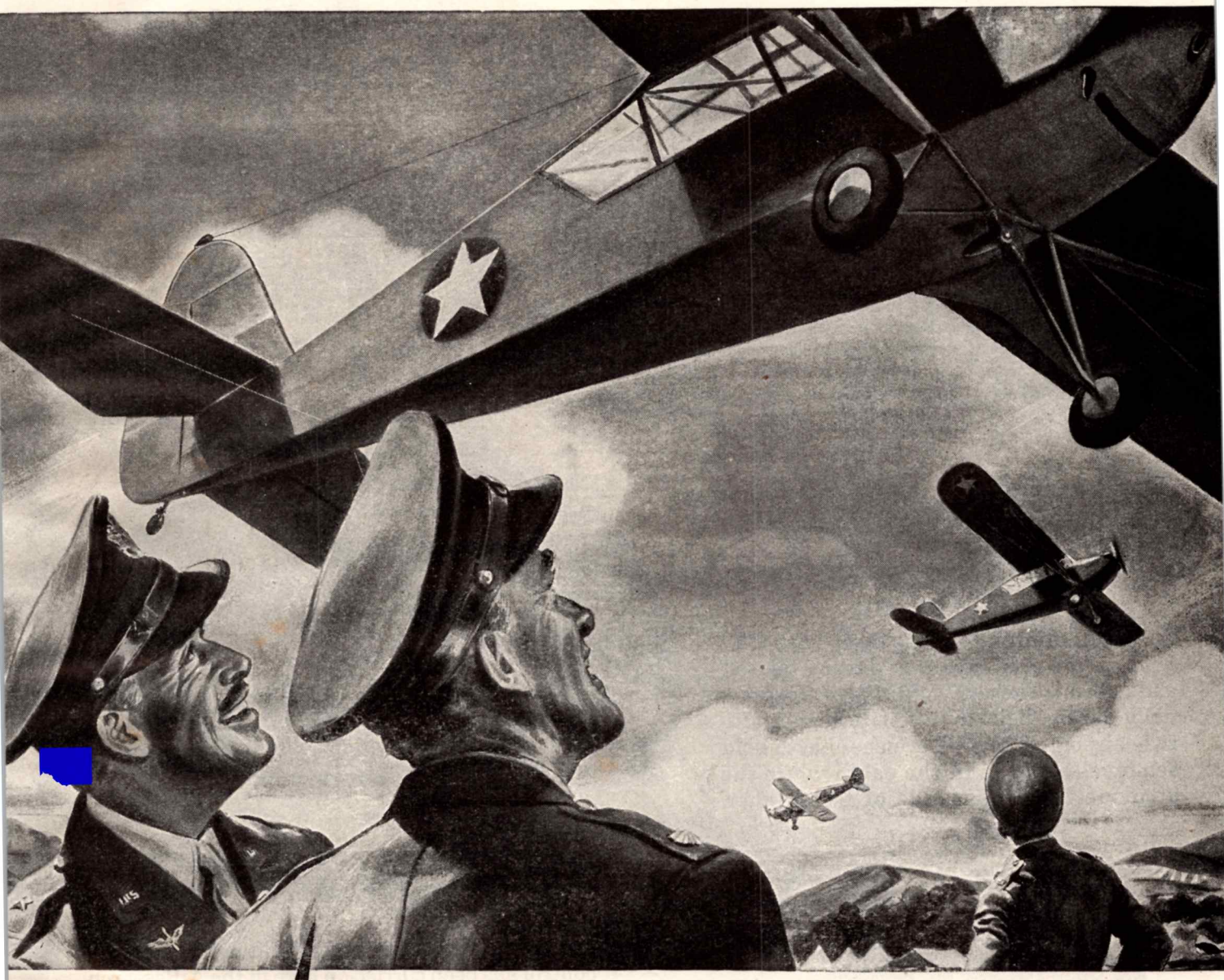
The initial cost of a two- or three-stage refrigeration system is approximately three times that of a dry ice system. It is possible to combine the advantages of both systems by using compressors to carry a steady base load and using dry ice to take care of infrequent heavy loads, or quick temperature reductions. Any desired speed of temperature reduction can be attained by proper design of the equipment. It is important that the chamber to be cooled is designed simultaneously with the refrigeration equipment. Adapting refrigeration equipment to existing chambers usually results in an unsatisfactory compromise.

Showing the time required to bring the temperature down to low levels. Beyond 30 min the temperature drop is slow



THEY'RE GRASSHOPPERS—B'GAWD!

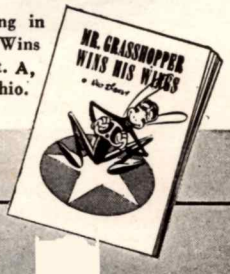
Abel Grasshopper . . . reporting for duty, sir! Able to climb quickly from restricted space . . . . . able to land anywhere—ready and willing to do any tough chore the Army may assign.



ANOTHER AERONCA FIRST AND FINEST... FIRST LIGHT PLANE COMPANY TO BE AWARDED THE ARMY AND NAVY "E."

War or Peace . . . when anything new takes place in lightplane progress, expect it to start with Aeronca . . . that's why Grasshoppers were born! ☆ ☆ ☆ Just a short time before America's official entry into the war, the Army decided to experiment with light planes under actual combat conditions . . . take-offs from small, bumpy fields . . . landings in congested areas . . . sometimes a country road . . . often just a common cow pasture . . . all kinds of weather . . . and constant alerts both day and night. ☆ ☆ ☆ And the easily handled Aeroncas came through all gruelling tests with such a record for dependability, that today, satisfied Air Corps Personnel allocate them for pre-glider training, liaison work with troops afield, artillery operations, and various other assignments for which their maneuverability and control qualify them. ☆ ☆ ☆ Officially designated as the Army's L-3-C . . . a keen-minded brass hat, after seeing them perform, promptly dubbed them "Grasshoppers" . . . We emphasize with modest pride this apt appreciation of Aeronca "First and Finest." Aeronca Aircraft Corporation, Middletown, O.

A full-color book to delight the young in heart . . . Walt Disney's "Mr. Grasshopper Wins His Wings". Send 10¢ in stamps to Dept. A, Aeronca Aircraft Corp., Middletown, Ohio.



WALT DISNEY

AERONCA

AERONCA

FIRST *Grasshopper* FINEST

© 1943—Aeronca Aircraft Corporation

WILL POSTWAR AIRLINERS FLY THESE LEVELS?

30,000 FEET

25,000 FEET

20,000 FEET

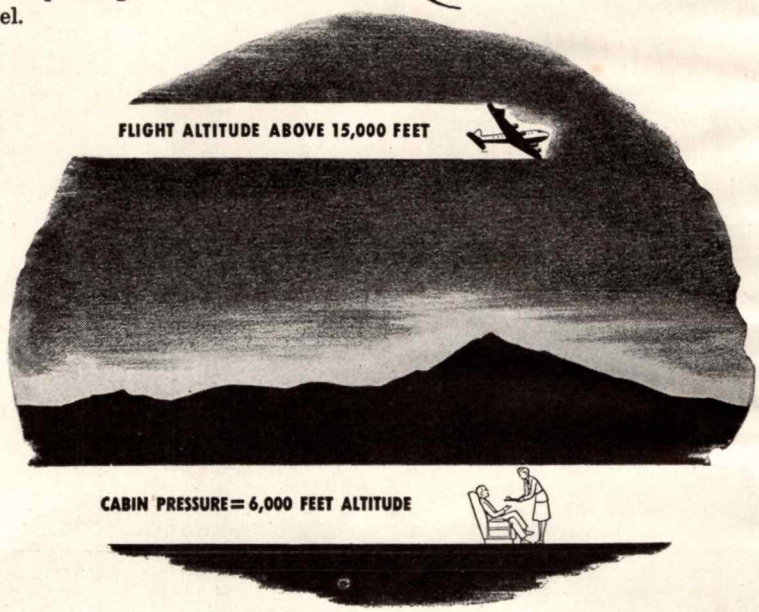
15,000 FEET

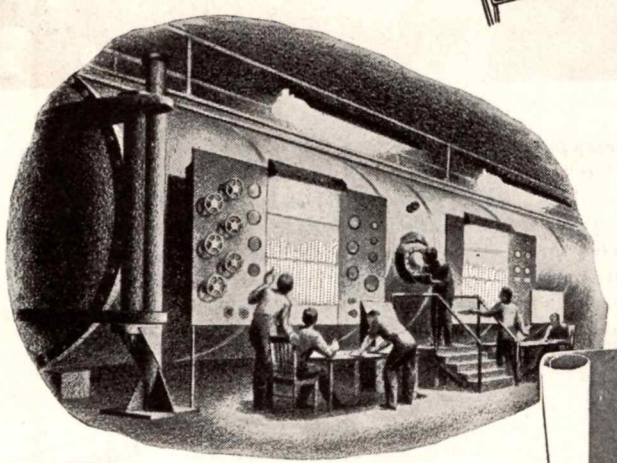
"It's something airline operators are looking forward to." Flying the higher altitudes will step up speed... cut fuel consumption... make possible smoother flights above storm conditions.

Up to now, passenger comfort has set the ceiling. For above 8,000 feet, most people's ears begin to pop. Above 10,000, they become sleepy and dizzy. These discomforts—due to lowered air pressures—must be overcome before passengers will take to high-altitude air travel.

Pressurized cabins will pave the way

They will eliminate these discomforts by *holding pressure constant* during take-off and descent. They will *adjust pressure* gradually during flight from low to higher altitude airports. They will even be able to hold sea-level altitude in the cabin while the airplane flies thousands of feet higher.





MUCH of the development work on cabin pressure control has been carried on here in the AiResearch "Stratolab". Our engineers have created altitudes as high as 65,000 feet—temperatures below minus 90° F. And they've found ways to control them!

The success of their engineering now assures pressurized cabins for postwar airlines. Information is available to aircraft manufacturers and airline executives.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES • PHOENIX
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does the Job" • Automatic Exit Flap Control Systems • Engine Coolant Systems
Engine Oil Cooling Systems • Engine Air Intercooling Systems • Supercharger Aftercooling Systems

NEW TECHNIQUES APPLIED TO ANTI-ICING PROBLEM

● A thermal system which makes indirect use of engine exhaust gases to preserve a safe minimum temperature on wing and tail leading edges, and an electrically conductive rubber strip which keeps propeller blade edges warm, are noteworthy recent contributions to the solution of the knotty problem of anti-icing.

The former development, conceived and in part elaborated by two engineers of the National Advisory Committee for Aeronautics, who, back in 1937, patented a continuous system for utilizing exhaust gases to generate steam for circulation in the wing-edges of a plane, has been perfected for use in the company's airplanes by Consolidated Vultee technicians working in collaboration with Lewis A. Rodert, senior engineer of the NACA.

Experimental Background

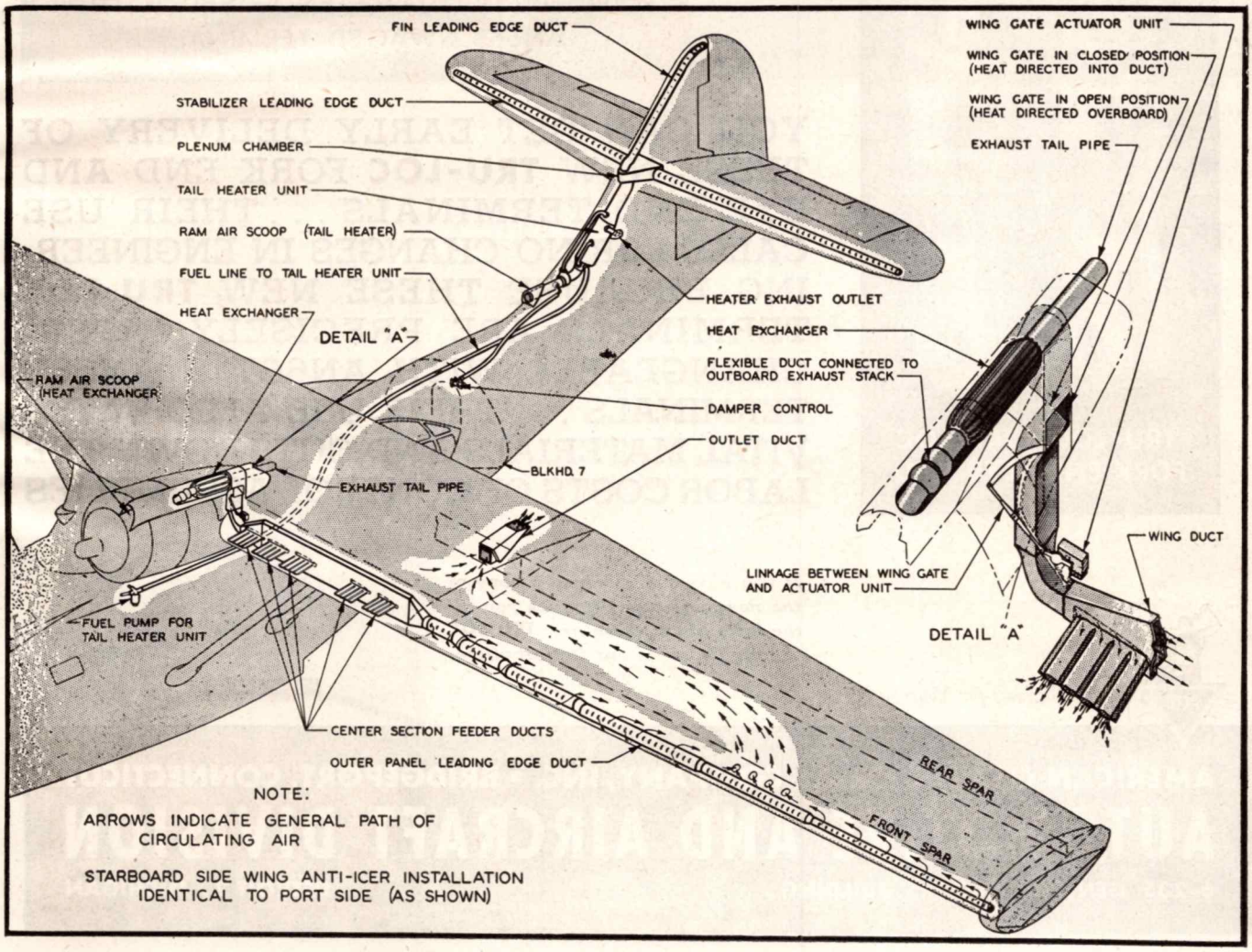
The experiments had been well advanced, employing Lockheed twin-engined planes for flight tests, when the NACA asked Boeing and Consolidated to join in conducting research on large aircraft. Both companies tackled the problem with success, although Boeing is not yet ready to proceed with its own thermal anti-icer installation until the equipment has undergone further flight tests. It is understood that other plane builders also are experimenting with the idea.

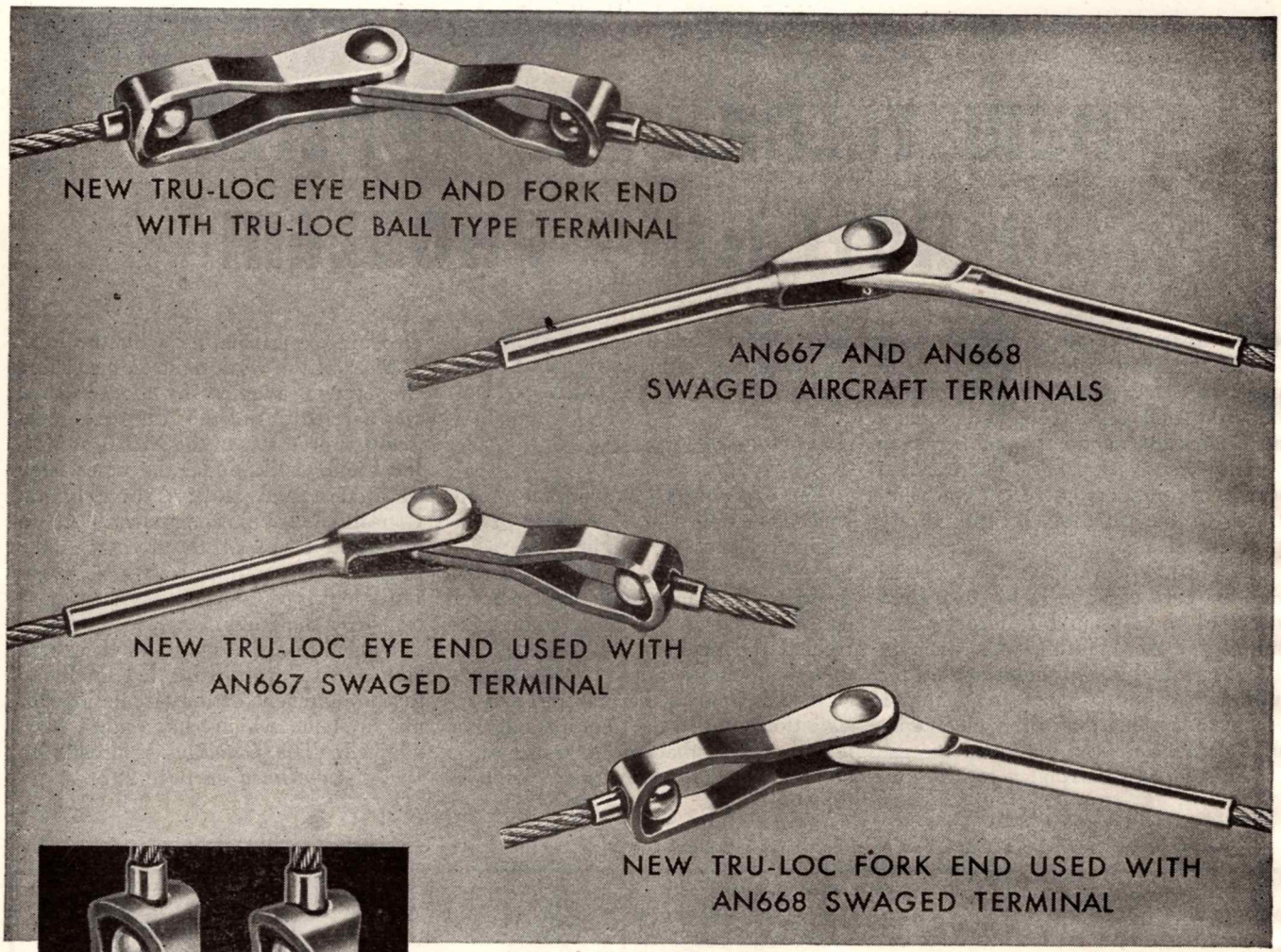
Most of the work done in perfecting the system adopted by Consolidated was carried out at the Ames Aeronautical Laboratories of the NACA at Moffett Field, Calif., under the supervision of Rodert and Howard F. Schmidt, Consolidated Vultee engineer. At an advanced stage of the research, the *Catalina* was equipped with a direct-radiating type anti-icing system and tested by the Navy.

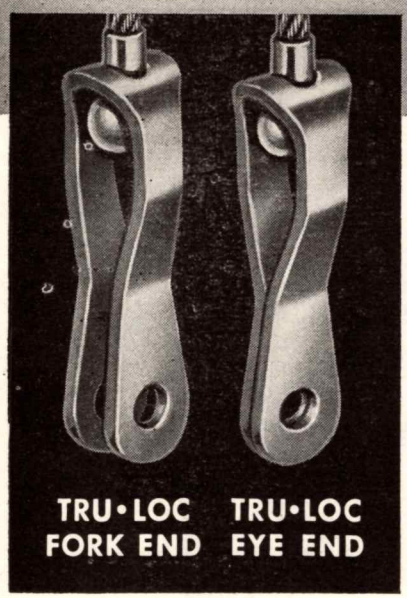
Difficulties due to thermal expansion and to overheating led finally to the development of the circulating hot air system which has now been adopted. The *Catalina* is already in

(*Continued on page* 227)

Thermal anti-icer system adopted by Consolidated for installation in the "Catalina." Arrows indicate general path of circulating air







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If you have not received a copy of the new bulletin that gives you all the facts about these new **TRU-LOC** *Terminals, write our Detroit office.*

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In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, INC. • BRIDGEPORT, CONNECTICUT

AUTOMOTIVE AND AIRCRAFT DIVISION

6-235 GENERAL MOTORS BUILDING **DETROIT 2, MICHIGAN**

(*Continued from page* 225)

production with the new anti-icer installation, and three other Consolidated Vultee aircraft—the *Liberator*, the *Coronado* and the P4Y-1, the new Navy flying patrol boat being built in New Orleans—are expected soon to follow suit. Details of the new system, as installed in the *Catalina*, appear in the accompanying diagram. Shown, is the port side of the plane, including engine, wing, fuselage and tail surfaces.

Air enters the ram air scoops on the engine nacelles. After passing through the heat exchanger, where outside air is indirectly heated by exhaust gases, the heated air travels chordwise through the feeder ducts in the center section. It also flows spanwise, escaping from vents in the outer panel leading edge duct. It then is forced to circulate inside the wing, heating it. Heated air is then discharged aft of the rear spar.

New anti-icing system for propellers employs strip of electrically conductive rubber attached to edges of blades. Passage of electricity warms rubber, preventing formation of ice

Heater Installation

A heater is installed forward of the tail surfaces. Air is drawn into the tail heater unit from the outside, a special line passing through the fuselage to deliver fuel to this unit. The outside air, heated in this unit, is forced into a pelum chamber, where it passes up the fin leading edge duct and along the stabilizer leading edge duct. Vents allow hot air to escape from the duct, warming the interior of the entire assembly.

The inset, "Detail A," shows the operation of the heat exchanger in more detail. The linkage between the wing gate and the actuator unit is portrayed, as well as the flow of heated air through the wing ducts. A study of the wing gate actuator unit reveals the fact that when the gate is closed the heat is directed into the wing, and that when opened (in warm weather) heat is directed overboard.

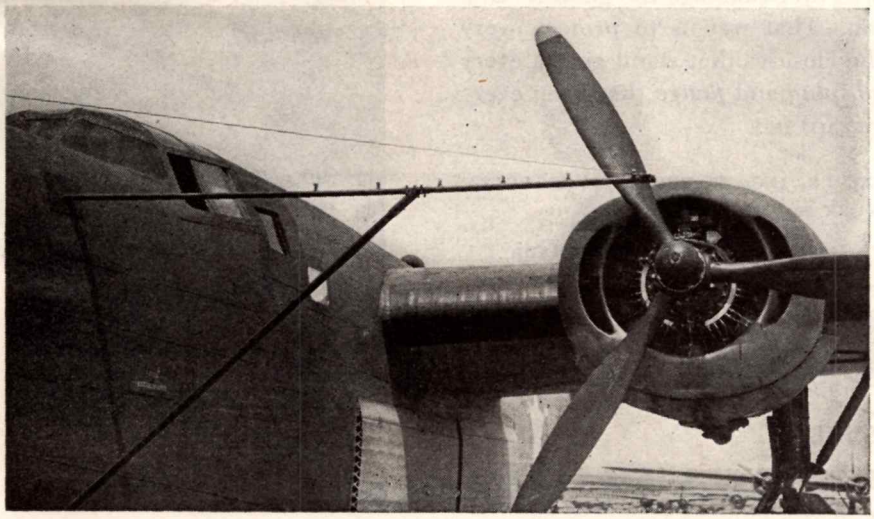
The *Coronado*, like the *Catalina*, has an auxiliary tail heating unit which prevents formation of ice from water splashed during take-offs and landings. The systems being installed in the *Liberator* and in the P4Y-1, on the other hand, call for heat to be drawn directly from the engines to the tail surfaces. In the *Liberator*, ducts carry heated air forward to the cabin and flight deck.

The advantages of the new system, which adds no weight to the aircraft, may be summed up as follows: (1) as ice never forms while in flight as long as the anti-icer is operating, there is no danger of it caking and acting as a spoiler; (2) as there is no loss of aerodynamic efficiency in either wing or tail surfaces, the anti-icer can be operated during combat, at slow flying speeds and during take-offs and landings; (3) destruction of accumulated ice and frost begins as soon as the engines of the aircraft are started during sub-freezing weather. Until now it has been necessary to clean off frost manually, a lengthy process.

Rubber plays the leading role in the novel anti-icing device for propeller blades just announced by the United States Rubber Co. Perfected by Dr. Louis Marick of the company's Detroit development division, with the coop-

(*Continued on page* 267)

Outrigger installed on bomber to induce ice formation on propeller blades, for experimental purposes. Water from tanks in bomb-bay is sprayed onto propeller while plane is in full flight



BELL AIRACOBRA
Courtesy
Bell Aircraft Corp.

What do you see...in a drum of gas?

A fighter plane, piercing the night with shafts of destruction, its engines purring a symphony of power — power that a fine pilot knows he can depend on, power that speeds a nation to victory — that is what you see in a drum of gas.

That is . . . if every drop of the gas has the same strength and purity when it comes *out* of the drum as it had the day it was put *in*.

There is a way to make sure of it — a way to make certain that no dust, no water, no human hands will ever sabotage the gasoline that great planes and flyers depend on. That way is to protect every drum with Tri-Sure Closures — the closures that stand guard, every mile and every minute, with a *seal*, *plug* and *flange* that keep every drop *inside* the drum and every hazard *out*.

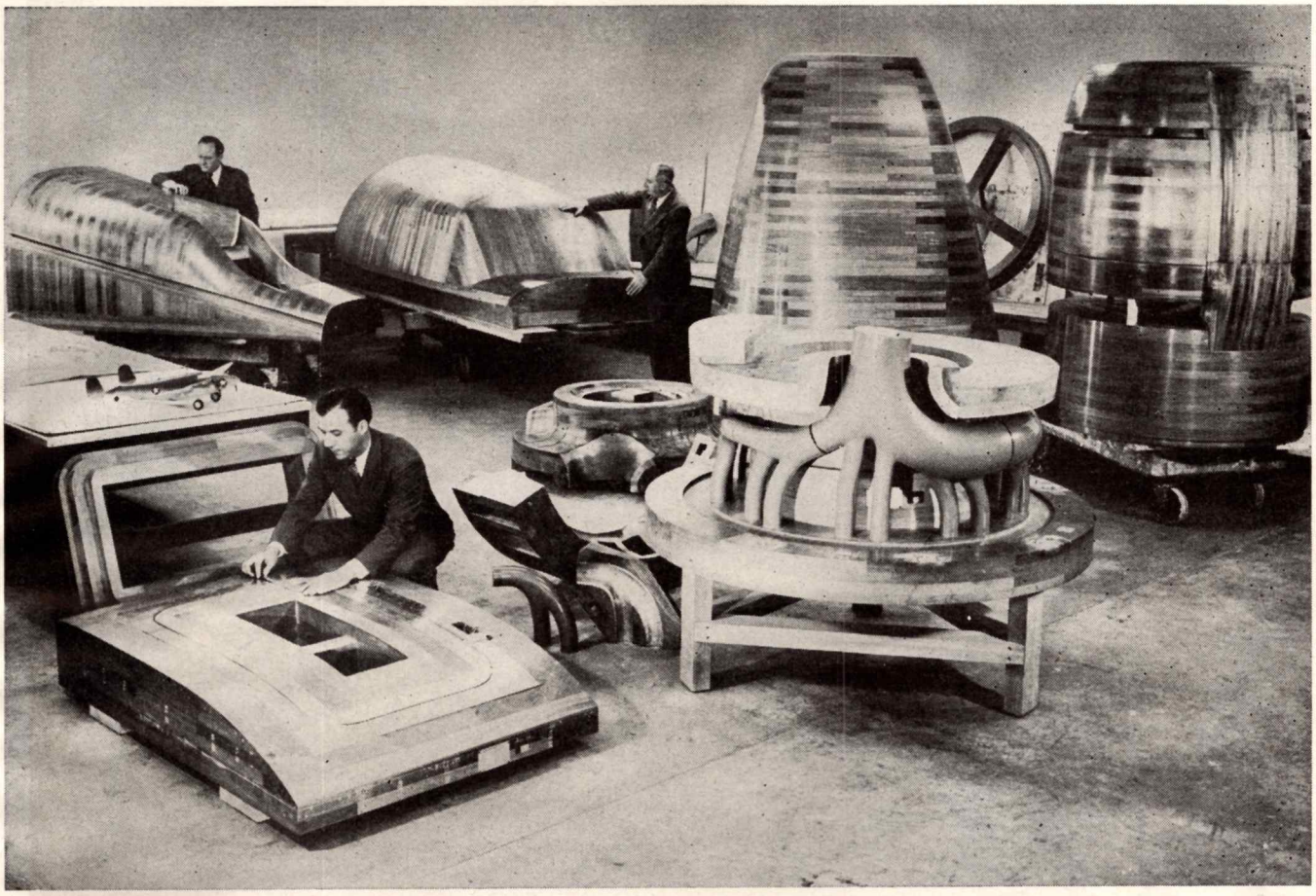
AMERICAN FLANGE & MANUFACTURING CO. INC., 30 ROCKEFELLER PLAZA, NEW YORK 20

TRI-SURE PRODUCTS LIMITED, ST. CATHARINES, ONTARIO, CANADA

Tri-Sure

CLOSURES

PROTECT THE FUEL THAT KEEPS 'EM FLYING



Mahogany steel or plastic master models of this type are used to make all production and prototype tooling by duplicating their shapes with fixtures cast in "Cerrobend." These fixtures are used to build and check all tools and parts involved in the contoured assembly

NEW METHOD OF MAKING METAL DROP HAMMER DIES

HARVEY G. GROEHN
Pres., Castaloy Corp. of California

● A novel production system for making drop hammer dies for prototype and sample parts, has been installed in the plant of Castaloy Corporation of California, at Los Angeles. Since 1940, Castaloy Corp. has been active in extending the adaptation of its special low-melting-alloy fixtures to airplane production requirements.

Steps in the Process

The uniform procedure thus developed embraces certain essential steps as follows: the construction of a master model or template, based on three-dimensional engineering information; the production of a plaster pattern of this master model, by casting; the casting of dies, embodying the identical contours of the master model, from the plaster pattern. Not only is a die thus produced, for stamping out of the parts; but at the same time a set of checking fixtures is made up, covering all subsequent operations on the part.

¶ A simple and quick method, as described in the September 1942, issue of AERO DIGEST, of making dies with which to form special parts has been worked out by Castaloy Corp. The method is unique in that a plastic mold is cast from a master model built in the pattern department. The final die shape is cast in soft metal using the plaster pattern as a mold. The soft metal die thus obtained is then reinforced by spraying metal onto it.

¶ Use is made of a soft metal alloy with a melting point so low that it can be pumped through a rubber hose. The molds are partially submerged in a cooling liquid and the newly cast dies are thus cooled within a short time. The final die is used for shaping certain metal and plastic aircraft parts and has a production life of from one to fifty such parts.

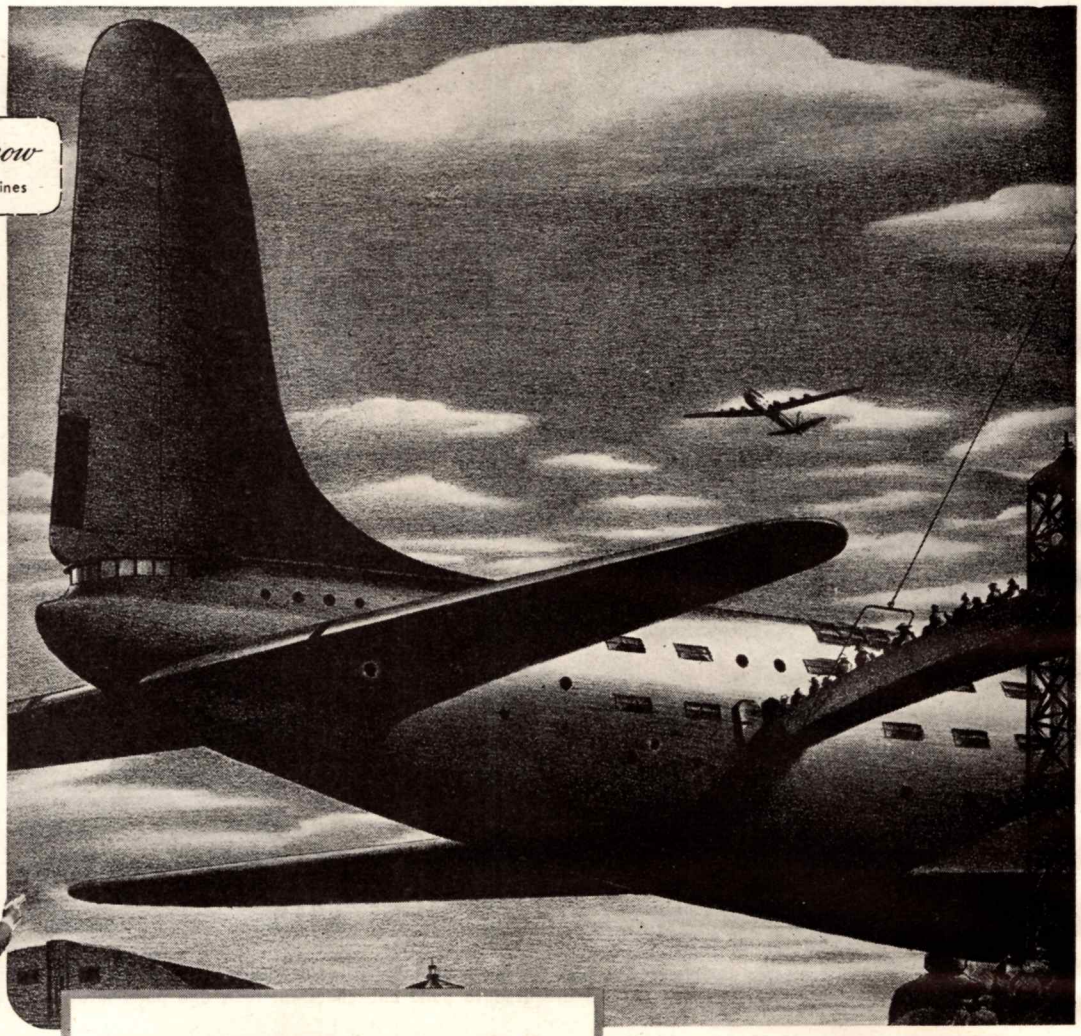
Rapid Cooling of the Die

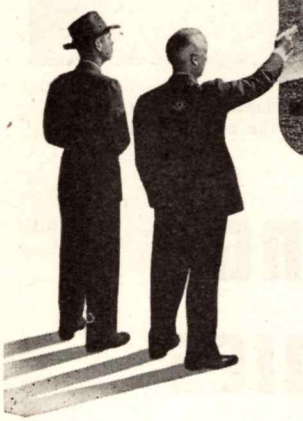
The new system of making dies is directly in line with these overall methods. The dies are cast directly from standard size plaster patterns of the part, in a large tank containing a circulating, cooling liquid. The cooling of a die is accomplished in approximately 45 minutes, the metal used being

(*Continued on page* 231)

Planes of Tomorrow

No. 1 Courtesy of United Air Lines





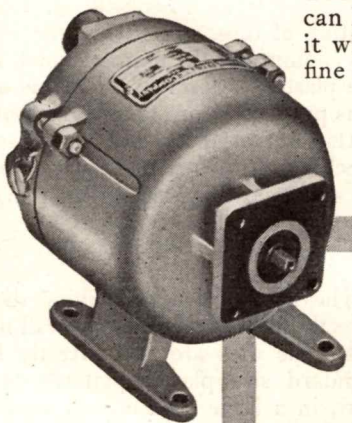
Automatic controls in this plane require 100 SMALL ELECTRIC MOTORS

Cargo and passenger planes of huge size are no longer a dream of the scientific writers. Present-day engineering advances, many of them covered with a cloak of wartime secrecy, make such planes entirely feasible when the men and materials are available to build them.

Small electric accessory motors will play a big part in operating the superplanes of tomorrow, just as they do in thousands of military aircraft today. You'll find them operating wing flaps, trim tabs, and many other controls which can hardly be operated by hand. The bigger the plane, the more small motors it will need. Bodine motors, now widely used in military planes, will have a fine background of experience for post-war applications.

Bodine Has Been Supplying Industry with Quality Fractional Horsepower Motors for Over 35 Years

Bodine Electric Company, 2280 W. Ohio Street, Chicago 12, Illinois

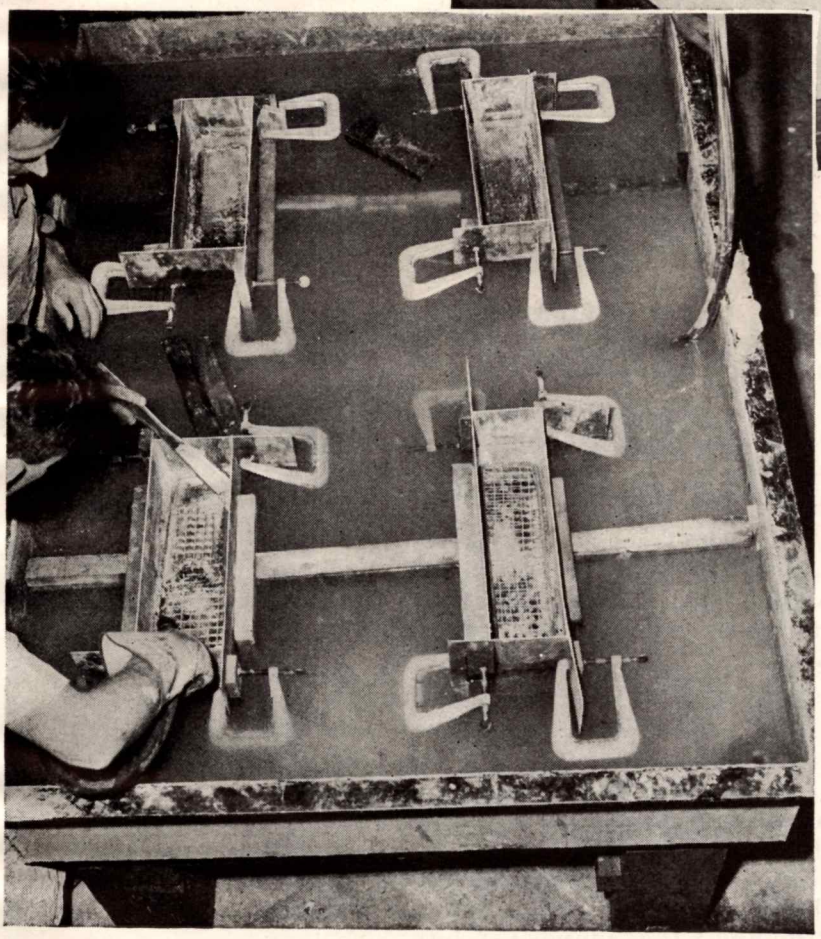


Bodine motors are built to meet or exceed Air Force specifications.

BODINE

FRACTIONAL HORSEPOWER MOTORS FOR AIRCRAFT ACCESSORIES

Right: Low melting alloy being pumped through hose into molds containing plaster patterns, against which dies for aluminum, steel, stainless steel and plastic parts may be cast. Below: Pouring "Cerrobend" punch directly against the die. Metal thickness is added to the die by a special spraying process



(*Continued from page 229*)

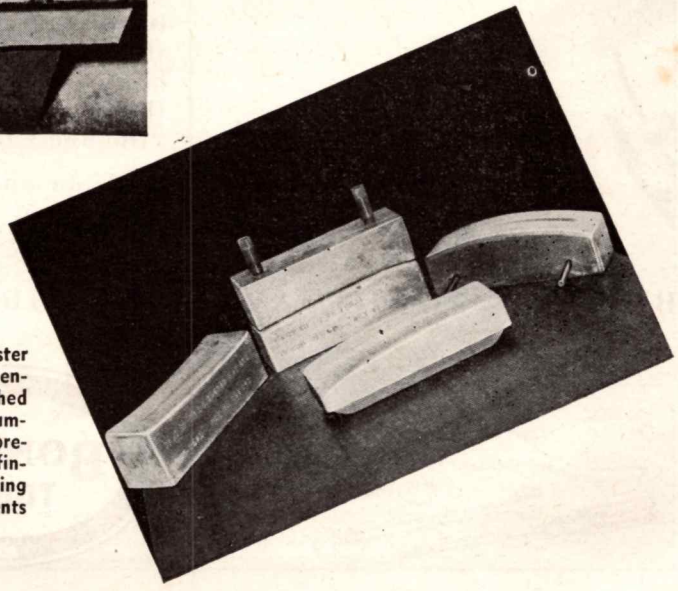
a standard alloy known as *Cerrobend*, which remains molten at such low temperatures that it can be pumped through a long rubber hose to any job that is ready for pouring.

This alloy is further distinguished by the fact that it does not shrink—a characteristic which sponsors the elimination of all problems involving machining, drilling or tapping in the case of fixtures or parts produced under this procedure.

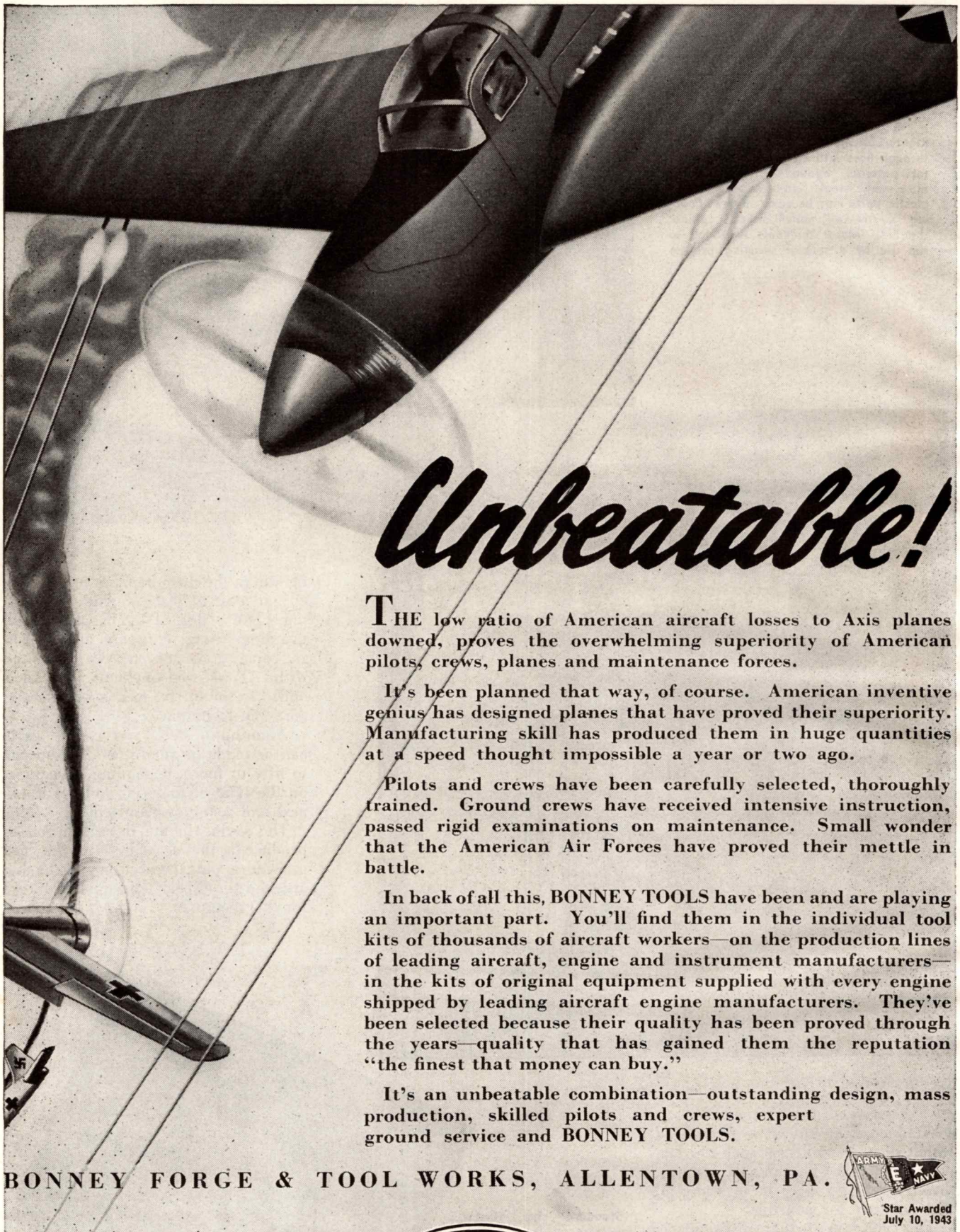
Anchor lugs and cores for holding the die in the drop hammer are mounted and cast in place during the pouring. The fitting of templates, and all grinding, filing, chipping and polishing operations are entirely dispensed with. The desired thickness of metal is added to the die by means of a special spraying technique.

Aluminum, steel, and plastic parts can be made in quantities of from one to fifty or more, depending, of course, on the type of material and the thickness and accuracy required.

The saving in the time required to produce a die according to the new procedure, plus the accuracy of the die, are said to bespeak a promising future for this method.



Standard size plaster pattern, at left; in center background, finished die showing drop hammer lugs; in center foreground and at right, finished die open, showing upper and lower elements



Unbeatable!

THE low ratio of American aircraft losses to Axis planes downed, proves the overwhelming superiority of American pilots, crews, planes and maintenance forces.

It's been planned that way, of course. American inventive genius has designed planes that have proved their superiority. Manufacturing skill has produced them in huge quantities at a speed thought impossible a year or two ago.

Pilots and crews have been carefully selected, thoroughly trained. Ground crews have received intensive instruction, passed rigid examinations on maintenance. Small wonder that the American Air Forces have proved their mettle in battle.

In back of all this, BONNEY TOOLS have been and are playing an important part. You'll find them in the individual tool kits of thousands of aircraft workers—on the production lines of leading aircraft, engine and instrument manufacturers—in the kits of original equipment supplied with every engine shipped by leading aircraft engine manufacturers. They've been selected because their quality has been proved through the years—quality that has gained them the reputation "the finest that money can buy."

It's an unbeatable combination—outstanding design, mass production, skilled pilots and crews, expert ground service and BONNEY TOOLS.

BONNEY FORGE & TOOL WORKS, ALLENTOWN, PA.

ARMY E NAVY

Star Awarded
July 10, 1943

SERVICE MANUALS for the ARMY and NAVY AIR FORCES

A. LUNDGREN
Engineer, Vega Aircraft Corp.

● Service handbooks, containing complete technical information covering every airplane, engine, and accessory order delivered to the Army or Navy Air Forces, are required of all government contractors. The basic requirements of the Army and Navy for airplane handbooks are the same. In fact, they form part of a recent standardization program for handbooks which has been approved by the commanding general of the Army Air Forces and by the chief of the U. S. Bureau of Aeronautics (for the Navy), as well as by the Air Council of the United Kingdom.

The modern combat airplane is such a highly complicated piece of machinery that it is difficult for anyone to learn and master all its technical intricacies under ordinary conditions. Now, with the enormous expansion of the air forces, when few skilled mechanics are available, unskilled labor has to be trained to do the work of skilled ground engineers. To meet this emergency, handbooks must contain all the information that a student mechanic receives at school. A complete handbook performs the duties of an instructor.

There are cases on record in which excellent equipment has been condemned or rendered useless because of lack of information regarding its proper care. There are also instances where combat airplanes have had to be grounded because there was no available information concerning their maintenance. To prevent such occurrences, service handbooks must contain all the information required by the men who must overhaul, service, operate and repair airplanes in the combat zone or in repair depots. They must cover all eventualities and leave nothing to the imagination. Handbooks must be carefully organized and indexed so that the information sought can easily be found.

There are three basic handbooks that must be furnished to the government air services 30 days before the first delivery: *Erection and Maintenance Instructions*, *Pilot's Handbook*, and *Structural Repair Handbook*. The cost of these manuals may easily equal that of an airplane, but if it can save the life of a single crew member or help to keep an airplane flying, its cost is well justified.

View of Vega layout room where service handbooks are prepared. To insure consistency and technical accuracy, preliminary sketches are made by a layout man technically versed in airplane practice

Maintenance Handbook

Erection and Maintenance Instructions is the most voluminous of the three basic books. Designed for the instruction of new mechanics, ground personnel in the squadrons, and of those working in repair depots, it gives complete information on the maintenance of the airplane.

The purpose of the *Pilot's Handbook* is to acquaint the pilot and the flight crew with the location and arrangement of the equipment in the new airplane which they are to operate. It includes complete flight operation instructions in tabular form, which simplifies the work of relatively inexperienced pilots.

The *Structural Repair Handbook* contains all the necessary information to repair the structures of airplanes, either in the field or in a depot, when damage has been caused in combat or by accident.

Since changes on new models are likely to be made up to the last minute before the first plane rolls out through the back door, they cannot be incorporated in the first manual, which must be available a month in advance of the first delivery. In such cases the contractor must make the necessary revisions and send them out as soon as possible.

Prior to October 21, 1942, the Army

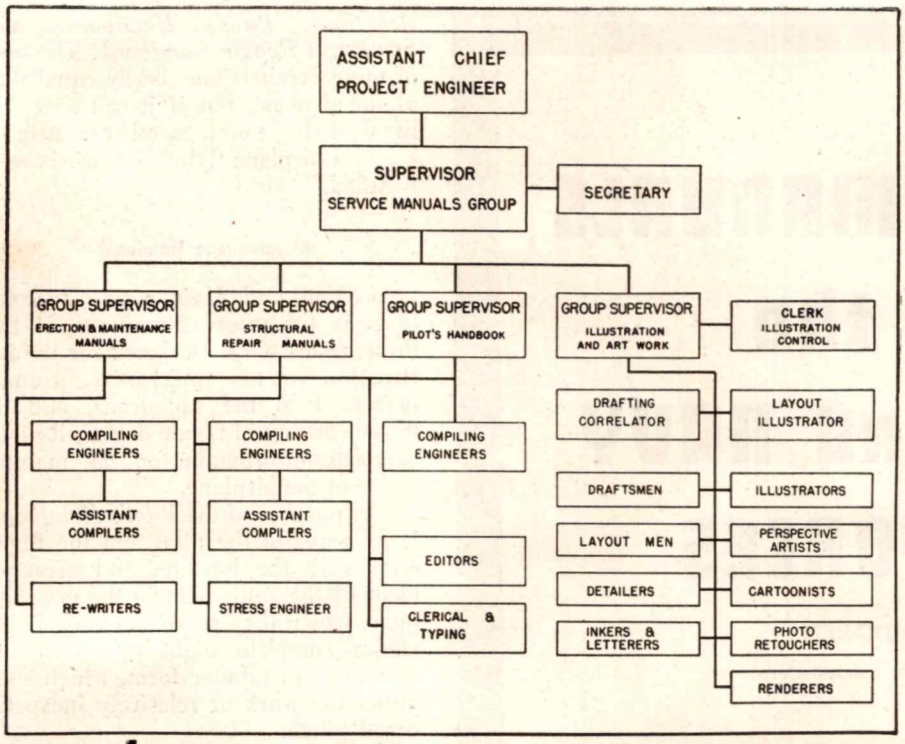


Fig. 1: How the service manual groups are organized at Vega

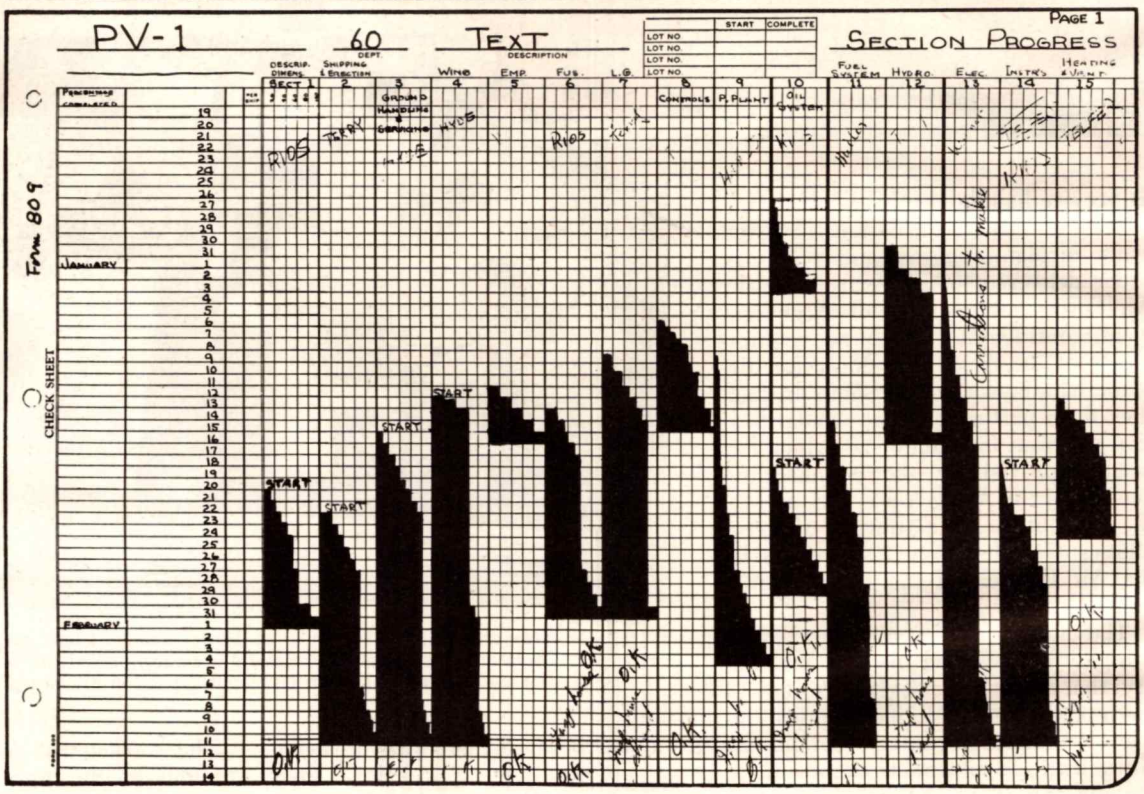


Fig. 2: Check sheet showing current status of a manual, with percentage of text and illustrations completed. Work must meet exacting schedules

and Navy had different requirements for handbooks. Now they both adhere to specification AN-H-7, which they have jointly adopted. This specification eliminates much duplication and simplifies the work of the different handbook groups. It is a general specification which covers the form of preparation, the arrangement, type setting specifications and scope. Other detailed specifications for erection, pilot's and structural repair handbooks have since been prepared and issued. Detailed specifications for handbooks are generally broad. They allow for the individual requirements of the two services and give the contractor enough freedom so that he can improve the arrangement of the handbooks.

The Army Handbook Branch, organized under the Air Service Command, has liaison engineers assigned to the various contractors and to the district areas. These men are specialists who supervise the preparation of handbooks. Their experience and intimate acquaintance with the requirements make them very helpful to the industry in the preparation of handbooks.

Handbook material, upon its approval by liaison engineer, is sent to the Army Handbook Branch at Patterson Field, Fairfield, Ohio, where it goes through a number of processes such as editing and styling. As an exception to this procedure, pilots' manuals first go to the Flight Test Section at Wright Field, Ohio, for verification of instructions on flight operations.

Final Preparation of Manuscript

All illustrations are carefully checked, pictures retouched and appropriate colors chosen. Colors are used rather extensively so as to give the books more eye appeal. Editors scrutinize the manuscripts for typographical errors, consistency of style and conformity to the requirements of the Air Corps. After final approval, the manuscript is sent to the printer.

The Handbook Branch has contracts with several large printing houses for the exclusive use of their facilities. All handbooks published by the Army are known as "Technical Orders." They are in loose leaf form, to simplify revision. The minimum quantity for a Technical Order usually is 6000 copies. They are generally reproduced by the offset lithographic method.

The term "manuscript," as used here, means a single page of the book, typeset and printed on white bond paper. Each manuscript page is repro-

(*Continued on page* 237)

REPAYMENT WITH *Deadly* INTEREST!

Grumman's TBF "Avenger"

Repaying the Pearl Harbor attack with grim generosity, the Navy has made full use of an aptly-named instrument . . . the Grumman "Avenger." At Midway and elsewhere, these carrier-based planes tossed 2000-lb. torpedoes or equivalent in bombs into many a Nip warship's vitals and marked the scores on ocean-floors! As a triple-threat, the "Avenger" conceals its belly-load to keep the enemy in wonder until the lethal package arrives.

But there's no wonder about "Avenger" reliability. Sturdy, yet assured of agility through Fafnir Bearing-equipped controls, it lays torpedo or bomb on the bull's-eye and regularly outmaneuvers and outfights intercepting planes.

This instant and precise responsiveness to controls is life-insurance to plane and crew . . . death-assurance to the enemy. Stability, rigidity and friction-free performance have been identified with Fafnir Aircraft Ball Bearings for many years. It will extend onward as Fafnir engineers cooperate with the aircraft industry in providing the exact bearing needed for each purpose in new plane design. The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

ARMY E NAVY

Send for copies Fafnir Aircraft Service Manual, you will find it an invaluable service guide.

FAFNIR
Ball Bearings
for Aircraft Engines and Controls

The Columbia won every event in its class at the 1926 National Air Races. In 1927, Clarence Chamberlin flew it from Long Island to Germany. In 1930, Capt. Errol Boyd and Lt. Harry Conner flew it from Newfoundland to England.

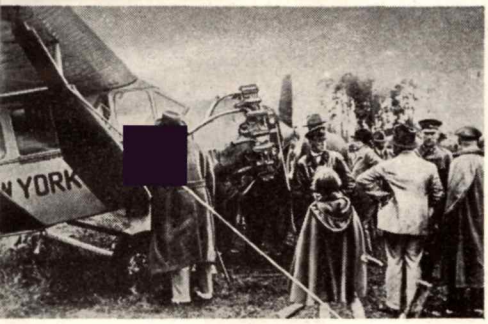
4,000 MILES NON-STOP FLIGHT TO GERMANY

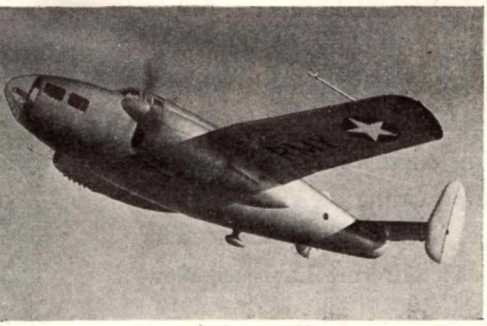
U. S. Army Air Forces Photo

This remarkable combat photo shows one of the unescorted B-17's in a fleet that rained destruction on the U-boat base and shops at Wilhelmshaven. Many of these powerful U. S. Army Eighth Air Force planes flew from America to England before they started their round-the-clock high level precision-bombing tasks over Germany.

Here is the answer to all Germans who thought America was "too far away." Had the Nazi leaders been a little brighter, they might have feared us sooner. Sixteen years ago, in 1927, a clear sign of American air prowess appeared in the German skies. It was the famous Bellanca long-distance cabin monoplane which flew over 4,000 miles to Germany in 42 hours and 45 minutes, non-stop, setting a world's record.

Today, the Bellanca tradition marches on in the production of the AT-21-BL gunnery crew trainer—precision-built armament equipment—and aircraft components for many of the United Nations bombers that are fighting for freedom in every theatre of this global war.





Above: at Kottbus, southeast of Berlin, where Pilot Chamberlin landed en route to Tempelhof Field, the Columbia gives this curious crowd something to think about. Below: the AT-21-BL gunnery crew trainer, now in production for the U. S. Army Air Forces.

KEEP ON BUYING U. S. WAR BONDS

BELLANCA AIRCRAFT CORPORATION

NEW CASTLE, DELAWARE

PV-2 SECT. TITLES	SECT. NOS.	TEXT						GALLEY PROOF						FIGURE CALLOUTS				FIGURE TITLES				TABLE OF CONTENTS							LINOTYPED MANUSCRIPT RECORD									
		DES. ENG. CHECK		FINAL EDITING		LINO-TYPING		PROOF READ		LINO-TYPING CORRECTION		SECOND PROOF READ		COPY	LINO-TYPING		PROOF READ	COPY	LINO-TYPING		PROOF READ	TEXT	LINO-TYPING		PROOF READ	PASTE UP	PAGE MAKE UP			PHOTO COPY	PASTE UP		PAGE MAKE UP		PAGE MAKE-UP REVISION		PHOTO COPY
		OUT	BACK	IN	OUT	OUT	BACK	IN	OUT	OUT	BACK	OUT	BACK		OUT	BACK			OUT	BACK			OUT	BACK		IN	OUT	OUT			OUT	IN	OUT	OUT			
LP&D.	1																																			
SHIPMENT & ERECTION	2																																			
GROUND HANDLING	3																																			
SERVICING	4																																			
WING	5-1																																			
EMP.	5-2																																			
FUS.	5-3																																			
CONTROLS	5-4																																			
P PLANT	5-5																																			
LUB. SYS.	5-6																																			
LAND. GEAR & BRAKES	5-7																																			
INSTR.	5-8																																			
FUEL	5-9																																			
HYD.	5-10																																			
ELEC.	5-11																																			
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OXYGEN	5-13																																			
HEAT & VENT.	5-14																																			
ANTI-ICING	5-15																																			
VAC.	5-16	3-13	3-15	3-15	3-16																															
ARM.	5-17																																			
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WT.	6																																			
MAT'L. & CONST.	7																																			
FINISH	8																																			
SERVICE INSPEC.	9																																			
GLOSSARY	APP I																																			
ALPH. INDEX.	APP III																																			

Fig. 4, above: Form for make-up of book, containing current status and dates for checking, editing, linotyping text, proof-reading of corrections, etc.

Fig. 3, below: Supervisor's control chart showing status of all current projects in service manual group

CURRENT STATUS OF WORK IN SERVICE MANUALS GROUP

MODEL	TITLE	PERCENTAGE OF COMPLETION					DATE TRANSMITTED	COMPOSITE STATUS	REMARKS
		TEXT	ILLUSTR	INDEX	PASTE UP	PRINTED			
B-34	PREL SERVICE MANUAL						9-15-42		
B-37	PREL SERVICE MANUAL						9-24-42		
PV-1	PREL SERVICE MANUAL						10-24-42		
37	PRELIMINARY REPAIR						9-15-42		NOT ISSUED
B-34	PREL PILOTS NOTES						9-15-42		
B-37	PREL PILOTS NOTES						9-24-42		
PV-1	PREL PILOTS NOTES						11-15-42		
B-34	ERECTION & MAINTENANCE						2-26-43		TO 01-55EA-2
PV-1	ERECTION & MAINTENANCE						4-14-43		
B-37	ERECTION & MAINTENANCE						6-17-43		TO 01-75EA-2
ALL	STRUCTURAL REPAIR						2-26-43		TO 01-55E-3
B-34	PILOTS HANDBOOK						3-2-43		TO 01-55EA-1
B-37	PILOTS NOTES						5-17-43		TO 01-75EA-1
PV-1	PILOTS NOTES						3-23-43		
B17F	E & M REVISIONS								TO 01-20EF-2
B17F	PILOTS REVISIONS						6-5-43		TO 01-20EF-1
YB-40	ERECTION						3-15-43		TO 01-20EF-2
YB-40	PILOTS NOTES						3-25-43		TO 01-20EF-1
B-34	COLD WEATHER						10-20-42		MANUALS ONLY
B-37	COLD WEATHER						10-27-42		MANUALS ONLY
XB 38	ERECTION								TO 01-20EE-2
XB 38	PILOTS NOTES								TO 01-20EE-1
PV-1	WEIGHT MANUAL								
PV-2	ERECTION & MAINTENANCE								
PV-2	PILOTS NOTES								
PV-2	REPAIR MANUAL								
PV-1	SHIPMENT MANUAL								PREL. PRINTING

(*Continued from page* 234)

duced photographically on a line negative. Space is provided for insertion of illustrations, which are photographed separately, either on line negatives for black and white, or through screens as in the case of half-tone illustrations. Illustration negatives are "stripped in" on the text negatives and the whole is transferred photographically to the zinc plates from which the book is to be printed. All handbooks are standardized at 8½ by 11 in.

After the books are printed they are distributed to the different Air Service Command activities and to the manufacturer. Copies of the handbooks are placed in the data cases of every airplane as it leaves the factory. In addition to supplying the contractor's stores with copies of the book for each airplane, every army depot, sub-depot, or service squadron in the first echelon receives copies for its files. Others, including contractor's field representatives, training schools, engineers and executives are also entitled to copies. Although the information contained in a handbook is classified as "restricted," the Army is always generous and ready to make it available to anybody who may benefit from it.

Centralizing the distribution of handbook data is the only way in which handbook revisions can be controlled, and the only way to provide assurance that no unrevised books remain in circulation. In view of the circumstance that pocket-size manuals issued by aircraft manufacturers for field representatives and training schools are certain to cause confusion, the Army is in favor of a single source of information: the Technical Order.

Navy Procedure

With the exception that handbooks are processed through the Bureau of Aeronautics, Navy procedure is much the same as the one just described. In certain cases the Army Handbook Branch has taken care of the printing of Navy handbooks; in others, the contractor has furnished printed books direct to the Navy.

Considerable planning is required on the part of the contractor who would meet the various stipulations laid down for his governance in preparing these manuals.

At Vega, the service manuals group is organized as shown in fig. 1. The manager of the group reports directly to the assistant chief project engineer. Functionally, the department is divided into an erection manuals group, pilot's manual group, repair manuals group, and an illustration group. The illustra-

(*Continued on page* 239)

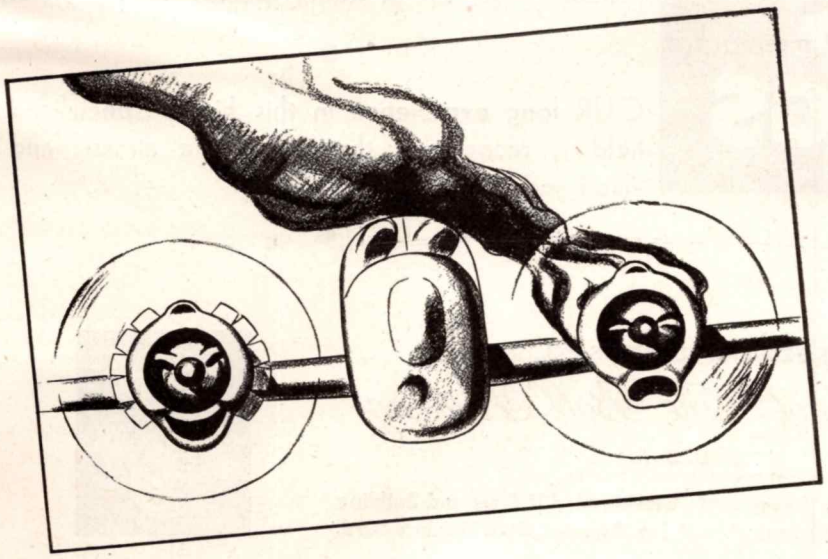

Fig. 5, left: Humorous cartoons are used to illustrate and emphasize the more important instructions

Strength ★ Toughness ★ Precision

Federal aircraft BEARINGS

THE FEDERAL reputation for QUALITY was established many years ago. Today, true to FEDERAL tradition, that same QUALITY is predominant in the fine control bearings we produce for the fighting planes of America.

●

OUR long experience in this highly specialized field is recognized throughout the aircraft and allied industries.

●

TRADE MARK

THE FEDERAL BEARINGS CO., INC.

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U. S. A.

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Chicago: 902 S. Wabash Ave. • Los Angeles: 5410 Wilshire Blvd.

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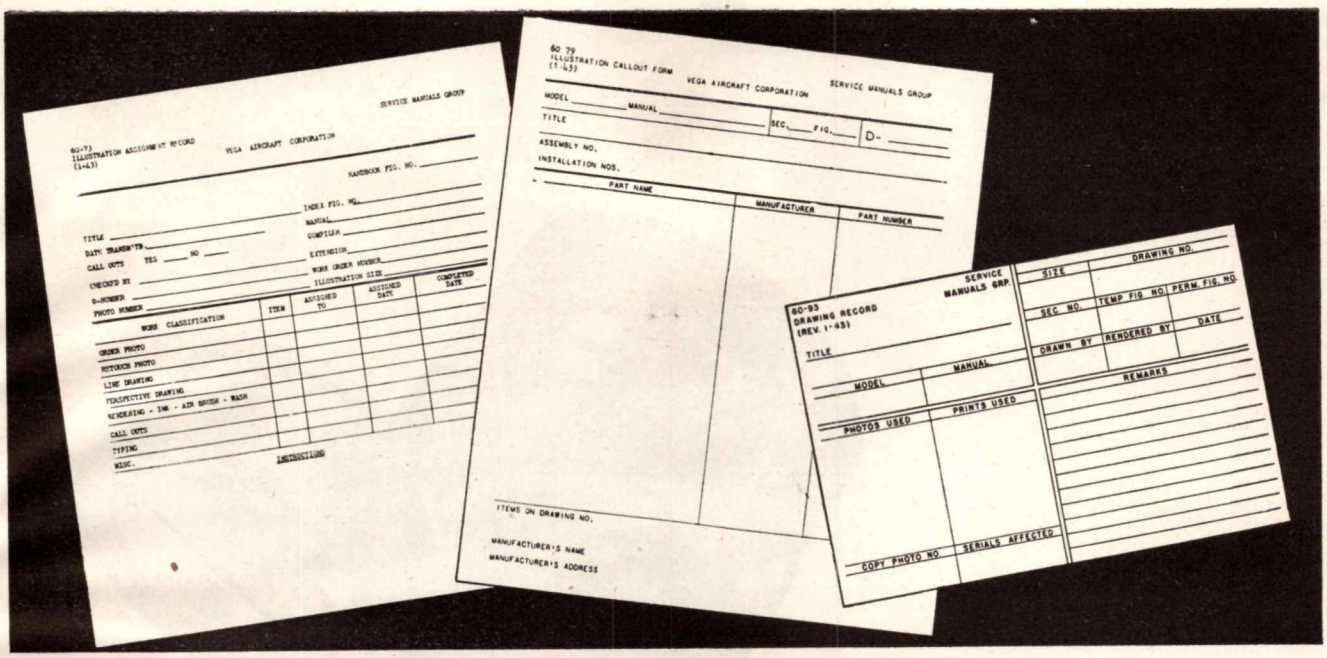


Fig. 6, above: Three forms embodying all information pertinent to illustrations. Compilers fill out an illustration request in triplicate—one for their record, another for supervisor and the third for the illustrator

(*Continued from page* 237)

tion group does work for the three manual groups.

To meet various work loads efficiently, the organization of the service manuals group is flexible. A nucleus of personnel is kept in the group at all times. Adjustments for varying loads are accomplished by transferring personnel to other groups. In slack periods, artists and illustrators may go temporarily to preliminary design, production illustration, parts catalog, or service bulletin groups, and compilers may be assigned as engineers to project design groups.

To insure uniformity in the work,

Fig. 7: "Callouts" are given reference in legend below picture, which gives names of part, reference number and vendor's name and address

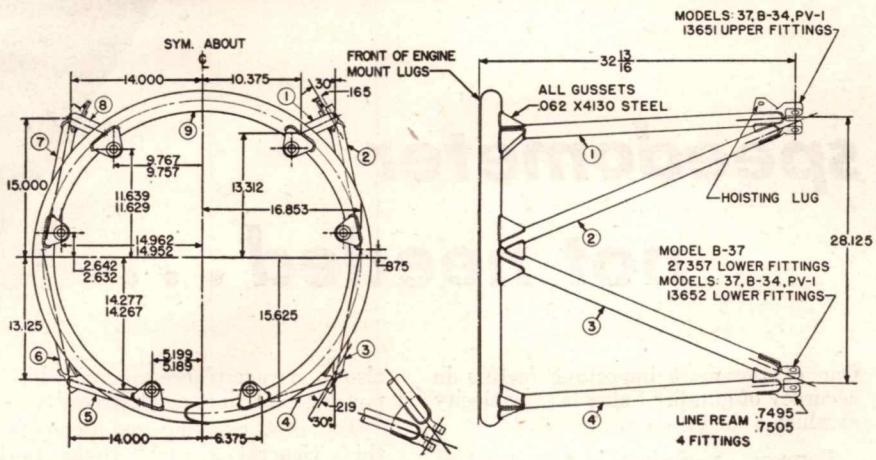
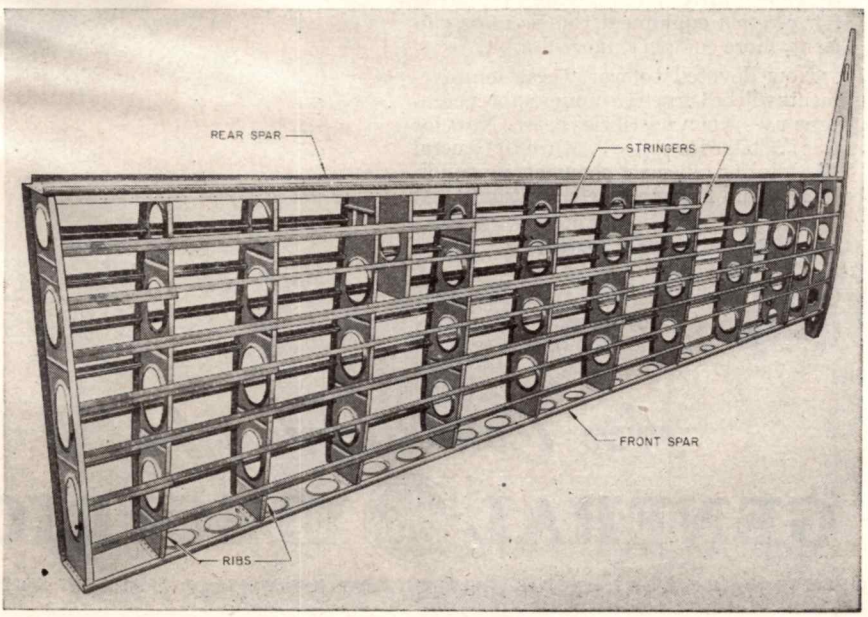


Fig. 8, below: Illustrations include perspective drawings from photos, such as this, engineering drawings of parts and retouched photos



every new employee receives an instructions booklet which outlines the separate responsibility of compilers, editors and illustrators. All procedures that are deemed necessary for the efficient control of the work are incorporated in this mimeographed booklet. Definite writing instructions are outlined for each new airplane model.

Responsibility for the information contained in the handbook rests on the compilers. These are engineers with several years' experience on the drafting board, who have also worked as shop contact engineers and field service representatives. Experience has proven that writing ability alone is not sufficient. So the compiler must be a technical man, and the writing subordinated to the compiling. Attempts to use scenario, radio, advertising and

(*Continued on page* 241)

speedometer not needed . . .

One of the most important factors in accuracy of gun-fire today is the velocity at which a shell travels.

Formerly, variations in the structure and dryness of the powder made great differences in shell velocity . . . and hence, made accurate gun-fire correspondingly difficult.

Today—thanks to technical advances in powder-making *plus air conditioning*—there is so little variation in powder that gunners can know *exactly* what shell velocity will be. Result—a more accurate gun-fire that has already contributed to important American victories.

Air conditioning keeps powder at the correct temperature and humidity levels, not only in the making of the powder, but also in storage places ashore and in powder magazines on shipboard.

To meet exacting requirements like this, General Electric engineers have developed *air conditioning* and *industrial refrigeration* equipment that is more efficient, more compact, more flexible.

Now devoted to war, these improvements will be turned to innumerable peacetime uses when hostilities cease. Now for war . . . later for peace . . . turn to General Electric for efficient, compact air conditioning and industrial refrigeration.

☆ BUY WAR BONDS ☆

General Electric Company, Air Conditioning and Commercial Refrigeration Divisions, Section 439, Bloomfield, New Jersey.

Air Conditioning by

GENERAL ELECTRIC

Listen to the General Electric radio programs: "THE HOUR OF CHARM", Sundays, 10 P.M., E W T, on N B C . . . "THE WORLD TODAY" News, Weekdays, 6:45 P.M., E W T, on C B S

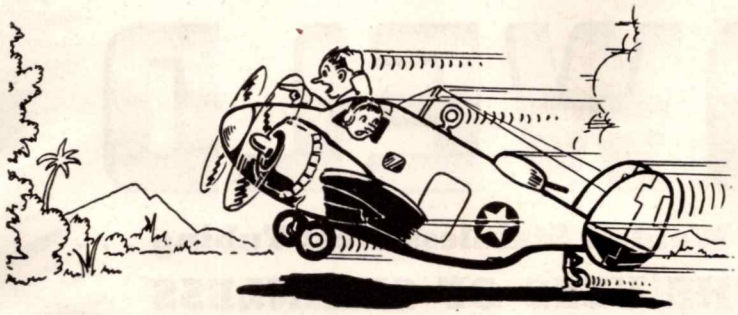


Fig. 9: "Check your load before you start, with librascope or loading chart"—an example of the useful purpose cartoons may serve

(*Continued from page* 239)

magazine writers, as well as school teachers, have been unsuccessful.

The use of such personnel now is limited to rewriting and editing. The editors check all material so as to insure consistency of style, correct English and conformity to the government style manual. They also do the proof-reading of linotyped galleys.

As the schedules are very exacting, systematic control of the work is necessary. The work is gaged by progress control charts, kept by the supervisors. The chart in fig. 2 shows the up-to-date status of a manual by indicating the percentage of text and illustrations completed. This chart is checked weekly. In fig. 3 the supervisor's control chart shows the status of all current projects.

Fig. 4 shows the form used to control the make-up of the book. It contains the complete status and dates for checking editing and linotyping of the text, as well as for proof-reading of linotyped corrections and second proof-reading of galley proofs. It shows the status of copy, linotyping, and proof-reading of figure titles. All this information for the table of contents is contained in a separate column. The last column covers the final linotyped manuscript record with columns for paste-up (ready, out), page make-up (in, check, out), page make-up revision (out, back) and date of return of the photo copy from the printer.

Specialized Work of Compilers

Each compiler is assigned to specific chapters of the book and to work with which he is familiar. Thus the same compiler writes the sections on power plant for all models, another covers armament, etc. The first step in the compiling assignment is to check project decision memos and to study the specifications and the general design descriptions which had previously been furnished to the group by the design engineers. The chief designer is responsible for these data being furnished on time.

The compiler then writes a detailed outline to determine the content and the breakdown of the subordinate headings. This outline must be approved by the group supervisor before writing starts. At all times the outline is kept ahead of the writing. To keep the illustration work in step, the compiler must decide far in advance upon the photographs and illustrations to be used.

Vega is trying to discourage "swivel chair" compiling, by having the compilers spend the greater portion of their time with the design groups in the shop and at the service field. The compiler is primarily a technician. Much of his material is turned over to a writer who tries to avoid the use of language that is too technical. Thus the books are written in simple language, to circumvent any possible misunderstandings.

Because of frequent changes in design and the fact that the compiler often discovers valuable information for the engineering department from his contacts in the shops with persons whose ideas do not always coincide with those of the designers, it is necessary to verify all the information contained in the rough draft before it is edited. The rough draft is then sent to the chief designer and the project engineer, who check and approve it.

An editor who is thoroughly familiar with the government requirements for style, is assigned to do the final editing, which includes English usage, punctuation, consistency and arrangement, in accordance with the approved outline.

After it has been edited, the rough draft is sent to the printer for linotyping. Linotype galleys are then proof-read by the editors, and the paste-up starts. To make up the dummy pages the linotyped text is pasted in the proper sequence and illustrations and call-outs arranged to follow the text. "Call-outs" are the circled figure numbers with arrows leading to details shown in the picture. The book is arranged so that illustrations and text correspond.

When the printer returns the make-up copies for check, final photo copies, which constitute the manuscript, are run off and transmitted to the proper government agency for printing.

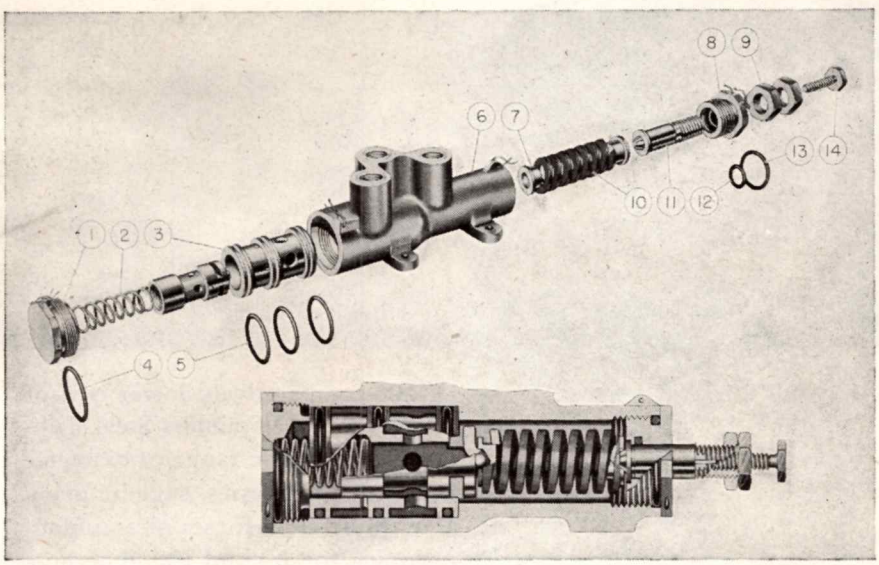


Fig. 10: A "pull out" drawing, showing cross section of part and sequence of removal or assembly of component parts

Many contractors, while awaiting printing and distribution of copies by the Technical Order, have advance copies printed. These copies are sent to Army or Navy units that have already taken delivery of the first group of aircraft, to the contractor's or customer training schools, to design engineers and to project offices. One copy is kept in the revision file of the service manuals group. As soon as the project office sends information concerning changes, a notation is made in the file copy so that the revisions will be picked up.

(*Continued on page* 277)

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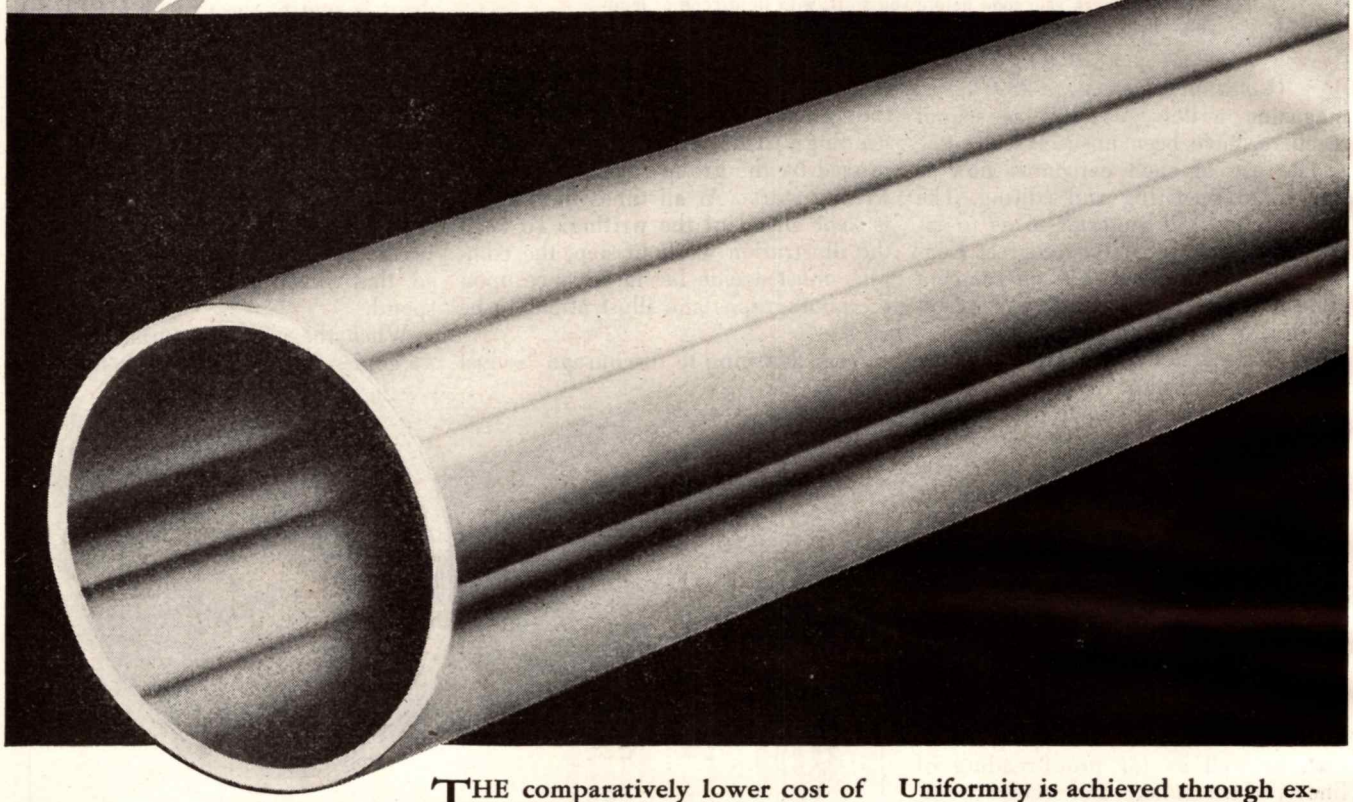

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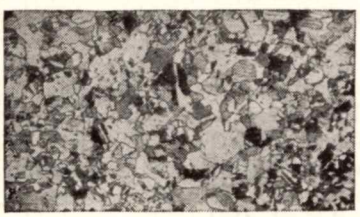

Photomicrograph of weld zone, showing grain structure of weld and parent metal.

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WEIGHING DATA AS APPLIED to STRUCTURAL ANALYSIS

JOHN C. REAMS
Chief Weight Engineer
Interstate Aircraft and Engineering Corp.

● Airplanes both commercial and military, are becoming larger, more complicated, more powerful and, of necessity, more costly. Parallel with this trend, the functions and responsibilities of the weight engineer have been expanded. His significance as a contributing factor in efficient airplane design is becoming better recognized every day.

As a prerequisite in preparing the stress analysis, the structures engineer must have available static shear and bending moment diagrams. Since the weight engineer compiles the original weight estimate and is familiar with the weight distribution of the airplane, it is only natural that the preparation of these data should be part of his curriculum.

Three Loads

There are to be considered in aircraft design three different loads: namely, external loads, internal loads and allowable loads. The external loads are composed of flight loads, landing loads, tail loads, and pressure loads which, in turn, are dependent upon the gross weight, landing weight, load factor, and the configuration of the plane. Internal loads are dependent upon the type and shape of the structure. Allowable loads are dependent upon the fiber stresses of the material used and on the general characteristics of the structure. The accuracy with which these loads can be determined depends to a great extent on the accuracy with which the shear and bending moments are determined. Accuracy here, in turn, is dependent on the correctness with which the weight and disposition of the components have been measured.

In the preparation of the shear diagram, the wing, fuselage, or tail is considered as a simple beam. By definition, the shear along a beam is the summation of the concentrated and distributed weights acting in a vertical direction. Fig. 1 is a simple shear diagram for a cantilevered beam. This is applied directly in aircraft structural analysis. The wing and tail are considered as being cantilevered from the center line of the airplane. The fuselage is considered cantilevered forward and aft from the point where the wing loads are carried through the fuselage, that is, at the main ring or bulkhead.

The first step is to divide the components of the airplane, *i.e.*, wing, fuselage, or tail, into a number of sections. Judgment must be used in determining the size and number of these sections, consistent with the size of the airplane. However, it is believed that no one section should be larger than 10% of the over-all length of the fuselage or of the semispans of the wing or tail. The weight determined for each section should include the weight of the constituents within that section. In other words, it should be the combined weight of the structure, electrical equipment, furnishings, etc., located within the section under consideration.

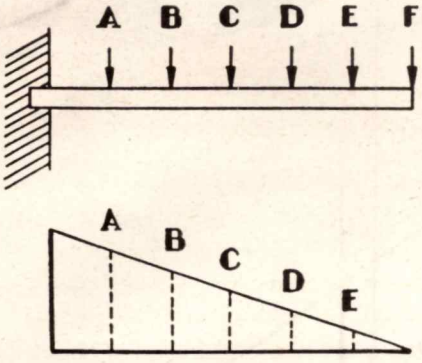


Fig. 1: Simple shear diagram for cantilevered beam

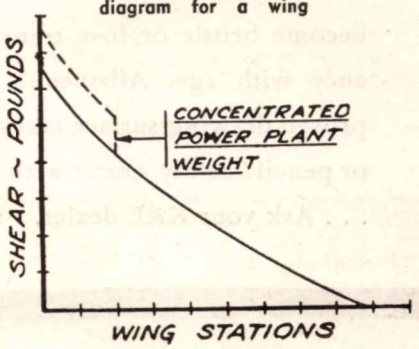
Having arrived at these weights, they can be compiled for use into forms as shown in figs. 6 and 7. The values thus obtained can then be plotted graphically into a shear diagram. This is accomplished by using the shear value as the ordinate and the distance as the abscissa. Fig. 2 is a typical shear diagram for a wing. The dotted line shows the effect of adding a power plant installation in the wing and considering it as a concentrated weight.

It is often necessary for the weight engineer to estimate the shear values long before he has sufficient information to follow the procedure outlined above. In such instances, assumptions will have to be made. Shear values can be estimated with a fair amount of accuracy by working with the structural weight; however, the distribution of the remainder of the weight depends upon the particular design and configuration of the airplane, and an intelligent estimate is the best that can be hoped for. For distribution between wing and fuselage, the approximate values as shown in the table at the end of this article can be used. The distribution within the wing or fuselage should be estimated consistent with the general layout.

To estimate the structure distribution for the fuselage, sufficient accuracy may be obtained for this stage of the analysis by proportioning the weight according to the projected area of the fuselage. It is to be realized that this is not exact, since the unit weight of

(*Continued on page* 245)

Fig. 2: Typical shear diagram for a wing



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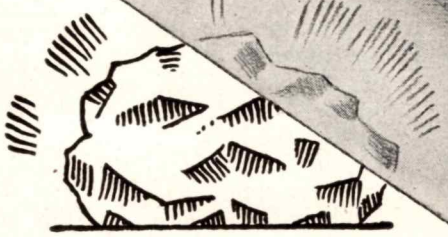

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(*Continued from page* 243)

that section adjacent to the wing is heavier than that at the nose; nevertheless, the percentage of error in the over-all estimate will not be excessive. The shear for the wing structure alone can be approximated from values shown in fig. 3. Equipment-weight distribution may be handled similarly to that of the fuselage.

So that the structures engineer can select a section to carry a given load, he must know how the bending moment changes at various sections. For this purpose the bending moment is to be calculated at various sections and plotted as in the shear diagram. The figure thus obtained is called the bending moment diagram.

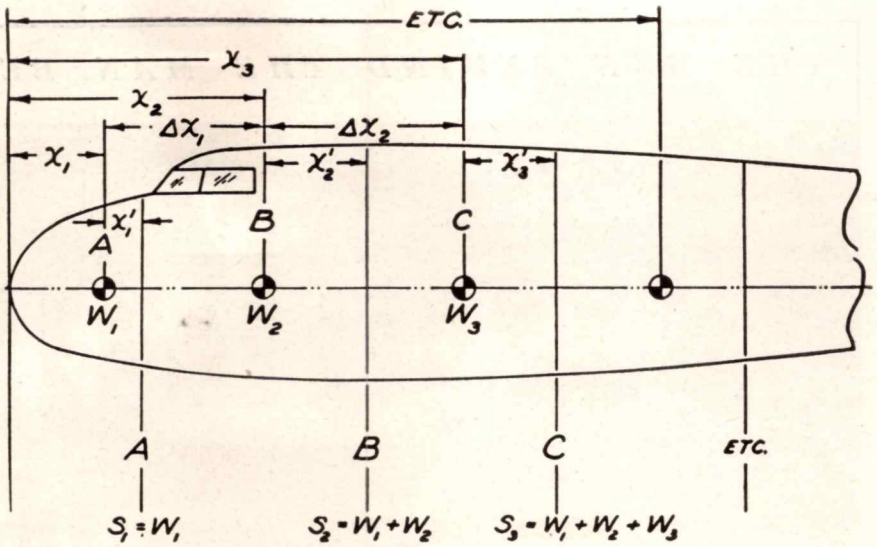


Fig. 4: For reference in calculating bending moment

Calculation of Bending Moment

The bending moment at any section is the algebraic sum of the moments to the left or right of that section, as the case may be. However, it is general practice in aeronautical engineering to consider the airplane to be facing left and the left wing to be facing forward. The bending moments are calculated accordingly.

In calculating the bending moment, it is convenient to have a tabular form to simplify calculations. The two shown in figs. 6 and 7 will prove very helpful. These forms were constructed from the following calculations. As in preparing shear diagrams, it is necessary to divide the airplane into sections. Knowing the weight and referring to fig. 4, the bending moment for section A at S_1 will be:

$$BM_A = (S_1)\ (X_1^1)$$

Then the bending moment for section B at S_2 will be:

$$BM_B = (S_1)\ (\Delta X_1 + X_2^1) + (S_2 - S_1)\ (X_2^1)$$
$$= S_1\Delta X_1 + S_1 X^1 + S_2 X_2^1 - S_1 X_2^1$$
$$= S_1\Delta X_1 + S_2 X_2^1$$

Continuing, the bending moment for section C at S_3 will be:

$$BM_C = (S_1)\ (\Delta X_1 + \Delta X_2 + X_3^1) + (S_1 - S_2)\ (\Delta X_2 + X_3^1) + (S_3 - S_2)\ (X_3^1)$$
$$= S_1\Delta X_1 + S_2\Delta X_2 + S_3 X_3^1$$

In like manner, the bending moment can be calculated for all sections of the fuselage.

In preparing the bending moment diagram, the values determined are plotted with the bending moment as the ordinate and the stations as the abscissa. A typical bending moment diagram for a fuselage is shown in fig. 5.

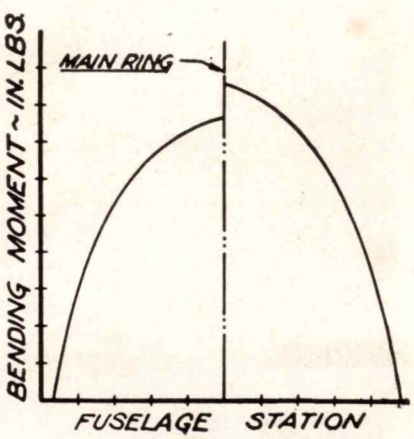


Fig. 5: Showing a typical bending moment diagram for a fuselage

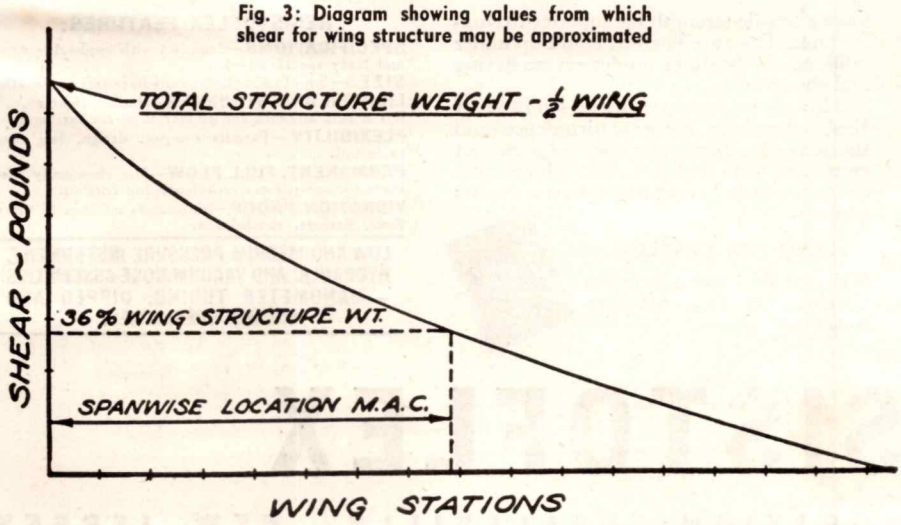
For preliminary work, it is not always necessary to go through the tedious calculations of determining the bending moment. As has been shown, the determination of the shear diagram is relatively simple, and can be used in attaining the bending moment. It is beyond the scope of this article to prove the relationship between shear and bending moment; however, the bending moment at any point is equal to the area of the shear diagram to the left of the point. In other words, to determine the bending moment, it is only necessary to integrate the area under the shear diagram with a planimeter and plot the values into the bending moment diagram.

It is noted that the tabular form prepared for the wing also includes provisions for the determination of torsional moment. This value is needed to determine the torsion or twist applied to the wing by the dead weight.

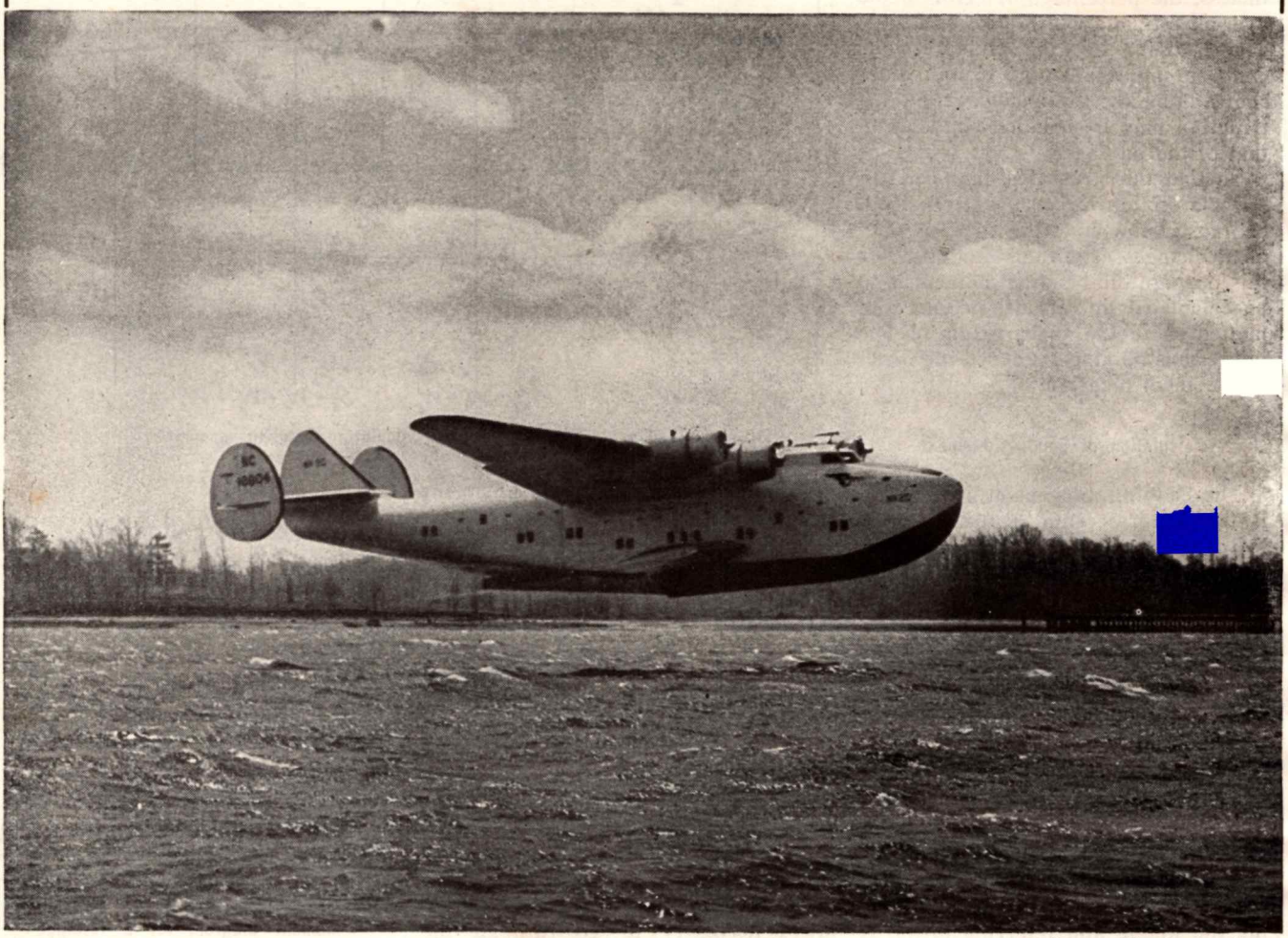
The foregoing presents a reliable method for constructing shear and bending moment diagrams. The accuracy with which these can be determined depends entirely upon the accuracy with which the weight and the disposition of the component parts are known or estimated. Care should be exercised in compiling these data for the final structural analysis. Roughly speaking, 35% of the gross weight is structure, of which approximately 75% is primary structure, consisting of stressed material working to a very high unit stress under the design load factors. This part of the airplane is directly dependent on the shear and

(*Continued on page* 247)

Fig. 3: Diagram showing values from which shear for wing structure may be approximated



THE MAN BEHIND THE MAN BEHIND THE STICK



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n		W	x'	z'	x	y	z	$y_R - y_{n+1}$	S	P	M"	y"	ΔM	M	Wy	Wx	Tyz	Wz	Tyx	Wx^2	Wy^2	Wz^2
					②-dx		②-dz	②R-②n+1	Σ" ①	②n ②n+1	Σ" ⑨	②n - sta.	②n x ⑪n	⑫n - ⑫n	①n x ②n	①n x ②n	Σ" ⑭	①n x ⑬n	Σ" ⑯	⑮n x ②n	⑱n x ②n	⑲n x ②n

1 STATION	CODE	2 WEIGHT AT STATION	3 C.G. FROM REF. PLANE	4 FIRST MOMENT	5 DIFF. IN ARMS	6 SHEAR	7 PRODUCT OF SHEAR & ARMS	8 MOMENT AT C.G.	9 C.G. OF WT. From STA.	10 PRODUCT OF SHEAR & X"	11 BENDING MOMENT	12 DIFF. IN ARMS	13 SHEAR	14 PRODUCT OF SHEAR & ARMS	15 MOMENT AT C.G.	16 C.G. OF WT. From STA.	17 PRODUCT OF SHEAR & X"	18 BENDING MOMENT
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n		W	x'	Wx'	Δx'	S	P	M'	x"	ΔM	M	Δx'	S	P	M'	x"	ΔM	M
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Headings of tabular forms employed in calculating the bending moment

(*Continued from page* 245)
bending moment and any error which may occur will subsequently cause the structure to become either over-stressed or under-stressed.

The following table gives a breakdown of equipment distribution in the fuselage of multi-engined aircraft, in percent of the total group weight—the remainders of the group weights are in the wing.

Fuselage Structure	100%
Powerplant Controls	23%
Instruments	100%
Surface Controls	45%
Hydraulic System	30%
Electric System	70%
Furnishings	100%
Anti-Icing	40%

If single-engine aircraft are being considered, the entire powerplant will be in the fuselage.

Propeller Blades Shielded During Test

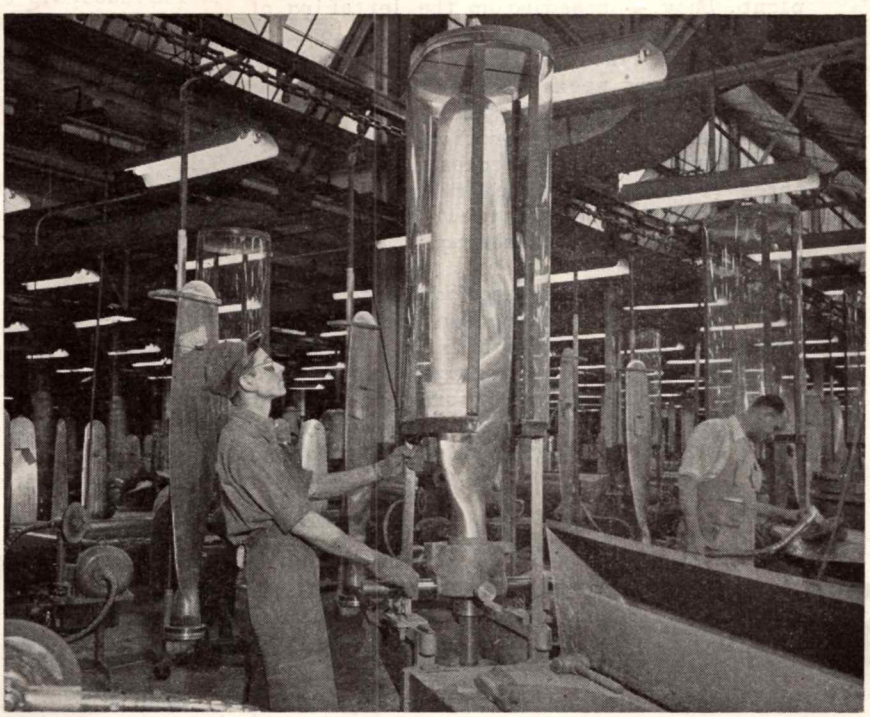
● Accelerated production of propellers has been achieved in the Frigidaire plant at Dayton, Ohio, through the use of a transparent plastic shield to guard propeller blades from air drafts during delicate balancing operations.

In the conduct of the balancing test, the fixture on which the blade is mounted is so accurately balanced that the slightest disturbance in the surrounding air imparts a pendulum motion to the unit, interrupting the operation.

Formerly, the balancing test was accomplished by removing the blade from the grinding bench and taking it into a special enclosed room in which there were no drafts. Since the operator had to make this test frequently to be sure that he was not grinding off too much metal, a great deal of time was wasted which obviously could be saved if only the balancing could be done on the bench.

The special transparent protective shield, which effectively prevents air drafts from striking the blade and at the same time permits the operator to see the position in which the blade finally comes to rest, has provided the answer.

As a result, the operator can now check the balance of the blade he is grinding in a matter of seconds. Besides saving time, this new procedure makes possible more accurately machined blades.



How transparent plastic shield is used on blade grinding bench

The new device has worked out so satisfactorily that Frigidaire is employing it in connection with the final inspection of propeller blades, in which highly trained teams of men and women double-check the balance of all blades before they are released for assembly into the finished propellers.

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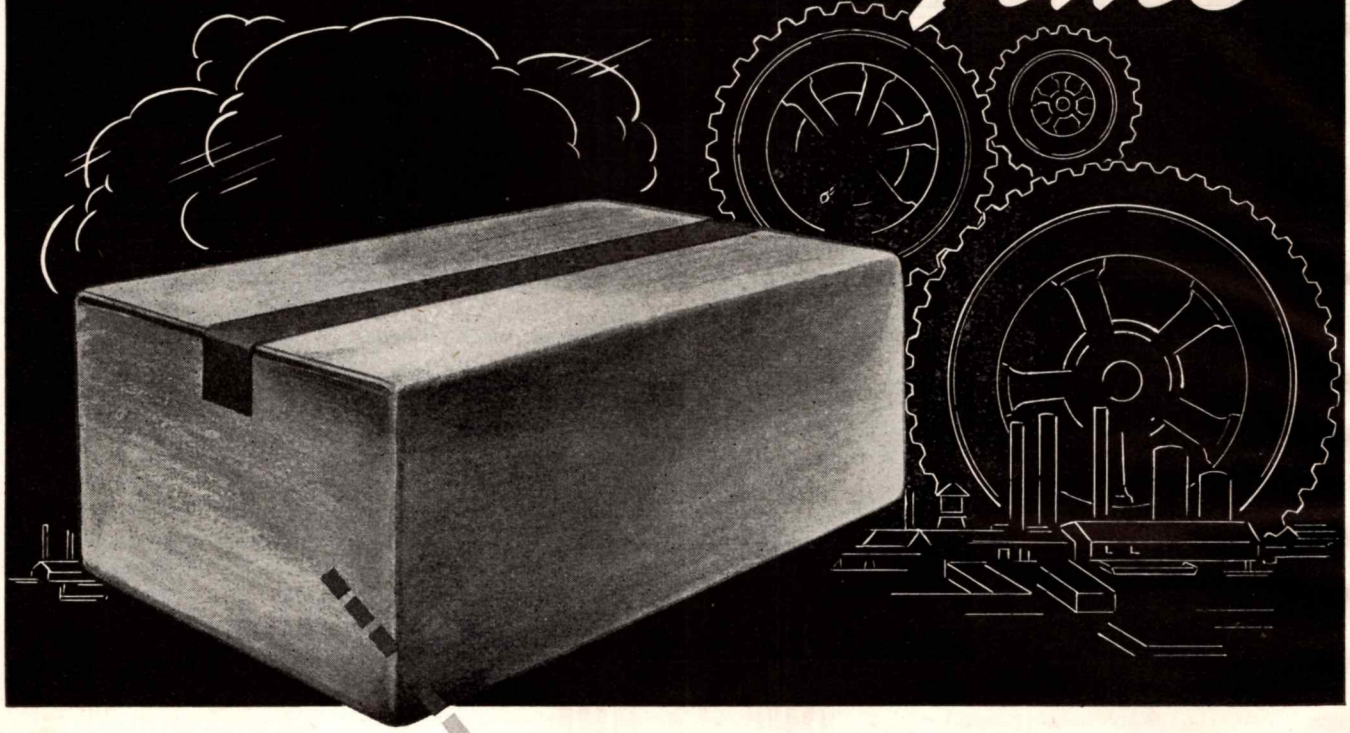

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MATERIEL COMMAND CHANGES STEEL WAREHOUSING PROGRAM TO EXPEDITE DELIVERIES

● To meet current problems in distributing steel through official aircraft warehouses, the Aircraft Scheduling Unit has effected three new features for expediting deliveries to aircraft contractors. These changes have been announced by the office of Capt. A. F. Hitchiner, Chief of the Warehouse Sub-Unit of the Materials Distribution Branch, under Lt. Col. A. E. R. Peterka, in the Materiel Command, Wright Field, Dayton, Ohio.

The changes cover three important phases of the warehouse program:

(1) Back Orders. Official aircraft steel warehouses are now permitted to accept back orders from aircraft contractors for small quantities of earmarked steel. The warehouses may accept back orders but may not hold the materials in the warehouse to fill these orders. The warehouses are not required to accept a back order but they will do so if the item is of a standard size normally carried by the warehouse, and if the warehouse believes it will be able to fill the order. If, at a later date, it appears that shipment cannot be made as scheduled, the warehouse will immediately notify the aircraft contractor, explaining the circumstances, so the contractor may immediately locate another source.

Releasing Material

(2) Release of Material from Warehouse. In order to expedite the release of steel from earmarked aircraft warehouse stocks—when the quantity required is greater than that permitted in the Earmarked Stock Directive—the Aircraft Scheduling Unit has authorized the Materials Coordinators in the District Procurement Offices to issue releases on all items, except steel tubing, which are required in quantities of five tons or less. For releases of quantities greater than five tons, it will be necessary to have the formal release made by Aircraft Scheduling Unit after certification of the emergency by the Procurement District Office. In making a request for a release for quantities greater than permitted in the Earmarked Stock Directive, the aircraft contractor must submit to the District Procurement Office full details of the reasons for the request.

(3) CMP Regulation No. 2. To assist manufacturers whose requirements for alloy steel—if specified over the period of their contract—would amount to extremely small quantities per month, the Aircraft Scheduling Unit has advised these contractors to utilize the provisions of the Controlled Materials Regulation No. 2. Paragraph C3 of that regulation permits an exception to the 60-day inventory restriction. Under this program, contractors may purchase up to the amount shown on Schedule A attached to that regulation.

For example, a contractor with scheduled requirements for 300 lb of 1-in round alloy cold drawn bars per month for six months may place an order with a warehouse for immediate delivery of the entire 1800 lb, since that amount is less than the 2000 lb maximum shown on schedule A for alloy cold finished bars.

The provision enables the manufacturer to accept deliveries of a controlled material even though the quantity of this material is greater than he would consume during the succeeding 60-day production period as provided in Controlled Materials Regulation No. 2, paragraph B1.

Aircraft manufacturers should remember, however, that while the regulation permits them to purchase up to 2000 lb of alloy or stainless steel, Earmarked Stock Directive Number 6 does not permit a warehouse to sell more than the quantities listed in Schedule B attached to that directive without special permission.

Manufacturers wishing assistance on any of these new phases of the steel warehouse program should contact their Procurement District Office.

AIRCRAFT FINISHES

(*Continued from page* 175)

to unanodized aluminum and will provide the best surface for subsequent finishes. If not too badly silked, the film—as in the case panel B—will have fairly good adhesion to the metal and provide a good surface for other finishes.

A badly silked film, recognized by the near-transparency of the glossy parallel lines, which add practically no color to the aluminum underneath, will account for only fair adhesion and provide little protection for the metal. Subsequent coatings, such as lacquers and synthetic enamels, however, do ahere well to badly silked primers. A slightly flocculated film will have only fair adhesion, will not protect the metal, and will provide a poor surface for other finishes. A badly flocculated film will aggravate the bad conditions developed by a slightly flocculated one.

A primer which has flocculated badly often has excellent resistance to hard settling, which would be an advantage to the manufacturer who uses the dip method of application. Thus, if the primers meet the requirements of the specifications and are further qualified by the manufacturer as to their resistances to hard settling and resistance to flocculation, they can be expected to produce excellent results when used in dip tanks.

In the finishing of properly prepared and primed metals, synthetic enamels or lacquer-enamels are always employed. Lacquer-enamels are generally used where production methods necessitate the use of quick drying finishes. Synthetic type enamels are preferred where the speed of dry is not important.

Metal lacquers of the non-specular types are those conforming to Army specification 14105, and Navy specification M-485. They contain 45% solids, and should be reduced with approximately equal parts of a thinner conforming to specification AN-TT-T-256 for proper spraying viscosity. If a gloss finish is desired, a lacquer conforming to specification AN-TT-L-51 should be used. This contains only 40% solids and should be reduced in the same proportion as recommended for the non-specular grades. Two coats of lacquer should be applied for adequate covering.

Where these lacquers are used, a finish of extreme durability and good resistance to the many chemicals and solvents encountered in the servicing and maintenance of military aircraft may be expected. Non-specular synthetic enamels are those conforming to Army specification 4109, and Navy specification M-543. They contain 60% solids and may be reduced with 20 to 25% of aromatic naphtha to proper spraying viscosity. Their durability and resistance properties are comparable to nitrocellulose finishes.

In the foregoing, some of the principal problems arising in connection with the formulation of protective coatings and in connection with their ultimate use in the finishing of wood, fabric, fabric-covered plywood, and metal aircraft have been covered—as they are encountered today. Nevertheless, due to the rapid evolution of new raw materials and new procedures in the formulation of protective coatings, the aircraft engineer who, in respect to the finishing of airplanes, would have his plant up to date at all times, should keep constantly in close touch with new developments in the field.

"CORONADO" PRODUCTION

(*Continued from page* 189)

connection of all control cables, and the joining of all fuel lines that were separately installed in the hull empennage and wing before arrival on the final assembly line. At station 3, electrical circuits are checked and some electrical inspection is completed. Instruments on the flight deck also are connected, operated and inspected. Station 4 continues the instrument checking, the operation and inspection of the de-icer system, and the installation of the propellers.

Operations, checks and inspections are continued at station 5, with the release system being operated and checked for both electrical and manual controls. Here also the auxiliary power unit is operated and inspected. Station 6 is a paint station. Here the *Coronado* receives its final paint.

At station 7, additional equipment is installed, such as cushions, fire extinguishers, safety belts and so forth. Here, too, controls receive their final inspection. By the time the ship leaves this station, all installations have been inspected at least once, and some have been finally checked off.

Station 8 is devoted to final checks, adjustments and the installation of any parts or equipment which failed to appear at their proper stations along the line, due to shortages or design changes. Leaving station 8, the plane is transferred to a special carriage that carries it sideways from the final assembly line to the last two stations, which are located out of doors.

Stations 9 and 10 are final clean-up and inspection stations. Fuel lines are flushed and gas and oil tanks filled. The plexiglas is cleaned and spark plugs are installed in the motors. Every final check and every inspection is made that must be passed before the ship is ready for flight testing.

Rolling off station 10, the airplane is transferred by written order to Flight Inspection for a final double check of the plane. This completed, Navy inspection makes its final check, and the ship is towed off the line and to the ramp for launching and flight testing.

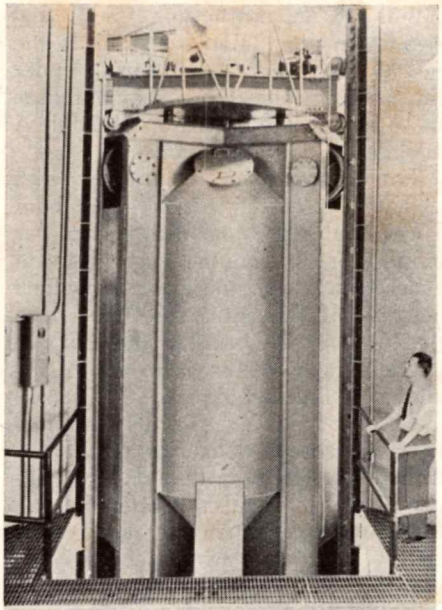
THE AMPLIDYNE

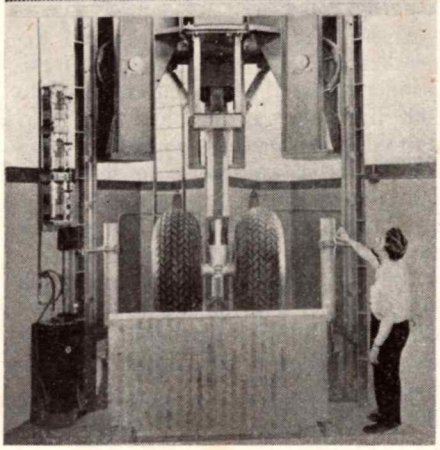
(*Continued from page* 179)

The new load current in the armature conductors cannot set up its own armature flux which would be directed from right to left, because any tendency in this direction is neutralized by a compensating field of equal and opposite strength. The output of 10,000 w is released by an excitation power of 1 w. This is an amplidyne.

Assuming that the excitation current is suddenly doubled, an increase from 1 w to 4 w (fig. 5) instantly doubles the short-circuit current, producing double output voltage (200 v) and forcing double current (200 amp)

Bendix Aviation Corp. is conducting practical experiments to meet the demands on hydraulic shock-absorbing landing gear struts that will be imposed on the heavier aircraft of the future. This trip hammer, which stands 45 ft high, drops with actual gear strut, simulating landing impacts of airplanes up to 400,000 lb gross weight. Precision gages record effects on landing struts





through the load. Thus, by merely raising the control input by 3 w, output is raised from 10 to 40 kw. To obtain comparable changes in output in response to minute changes of excitation with conventional generators would require two generators. A small control signal would excite the first one and the output of the first generator would excite the second. The output of this second generator would considerably amplify the small control signal to the first one but with a cumulated delay in response.

In the amplidyne, the equivalent of a full-size exciter (utilizing the same armature structure and conductors) is available to forcibly excite the output generator for fastest response. The speed of response of the amplidyne is further accelerated because the output flux is produced by the armature conductors from within the armature structure, so that even the flux which leaks through the air produces useful voltage.

The symbol shown in fig. 6 represents the amplidyne as two full-size generators "compressed" into one. The minute control field and the short-circuited circle are identified with the first stage. The compensating field and the other circle connected to the load are identified with the second stage.

Thus the amplidyne is shown as a two-stage amplifier responding to a single control field.

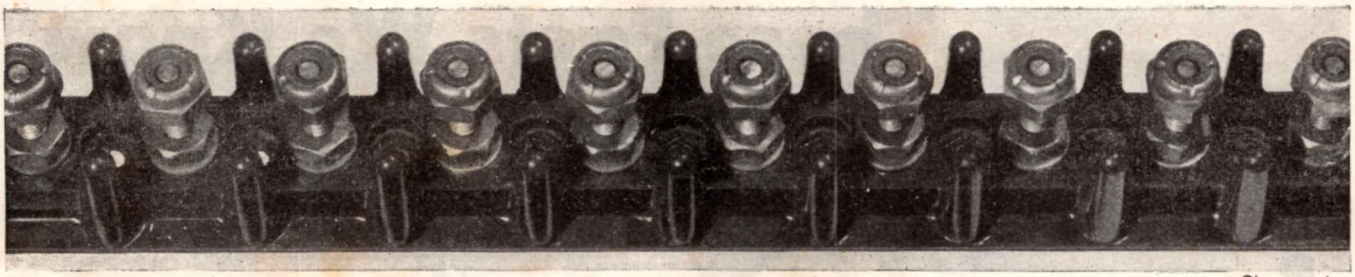
Multiple Use

If several control fields, independently excited from signal devices, are placed on the same pole structure, the amplidyne will respond to their resultant action and amplify it in the same manner as for a single field.

The small space required by the individual coil makes it possible to have a normal complement of four fields, permitting many independent functions to be controlled by the amplidyne output. Each of these fields is easily adjusted by a small resistor, or by other means. Since their current requirements are so small, their action may be automatically blocked by small rectifiers, as long as a certain operating condition or limit is not reached.

To summarize, the use of multiple fields in the amplidyne greatly reduces the number and size of control devices required. Because they are so small, these fields are easily adjusted within a much wider range than conventional fields. Considerable flexibility is thus built into the equipment permitting operating limits to be easily changed. Because the small amplidyne fields invite the use of a greater number of controls, automatic operation can be realized to a great extent. Because of the forcing action of the amplidyne, together with its practically instantaneous response, machines excited by it are made to deliver maximum performance under rapidly changing conditions. Finally, it should be noted that amplification of the order of 10,000 to 1 is obtainable with ease.

The amplidyne provides an entirely new combination of amplification and speed of response. Easy to work with, it is in every outward aspect similar to a conventional exciter. Because the amplidyne is a machine involving basic electro-dynamic principles, its construction can be simple and rugged, contributing toward long life and absolute dependability.



Close-up view

MOLDED CONNECTOR PANEL ASSEMBLIES

In Variety of Lengths, Complete with Hardware

READY FOR USE

As suppliers of molded plastic parts to the aircraft industry, one of our services is the manufacture of connector panels, illustrated here. These are molded and assembled complete with hardware, and delivered to you cut to the desired lengths • You save assembly time in your plant • You avoid loss due to scrap • You eliminate need for stocking hardware. Molded Connector Panel Assemblies are available in 2 types: NAS 18 *and* NAS 17. Quotations sent on request. Prompt deliveries.

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Brush Spring for Aircraft Radio Dynamotor

"Micro-Processed" for best combination of strength, electrical conductivity, and resistance to heat.

Design stress, 68,000 lb. per sq. in. for service at 270 deg. F.

Produced by the hundred thousand to tolerances of:

± .002 in on outside or inside diameter
± 4% on brush pressure at specified compressed length.

Calibrated Spring for Aircraft Instrument

"Micro-processed" for minimum drift and maximum proportional limit.

Design stress, 65,000 lb. per sq. in.

Produced by the thousand to tolerances of:

± .004 in. on free length
± .001 in. on outside diameter
1 deg. on squareness of ends.
± 0.6% deviation from standard deflection curve
0.2% maximum drift, full load for 24 hours

Flexible Centering Ring

Punched and formed while soft and ductile, then hardened to a tensile strength of 200,000 lb. per sq. in. "Micro-processed" by the thousands to hold center in plane of rim to within .005 in.

Illustrations Approximately Twice Size

THESE three beryllium copper springs may well be considered "fussy"—yet they were produced in the quantities noted—by the same production control routine used by Instrument Specialties Company on hundreds of less rigid but nonetheless important spring jobs.

These springs owe their success to "Micro-processing"—a precise technique by which the extraordinary spring qualities of beryllium copper are consistently predicted and controlled by I-S through every step of production, beginning with the spring wire itself.

Spring users are rapidly learning that they can expect more of their springs. As a result, many manufacturers are designing more service life into springs; are setting up and are obtaining closer tolerances and improved electrical qualities; are making steady use of our ability to control drift performance when necessary.

These are statements of fact which we can back up to the hilt. There is no better test of micro-processing than on your own springs—those now in use or on your drawing boards. Whether your requirements are as rigid as those illustrated or not, you can expect and will obtain, improved performance and greater freedom of design when you use "Micro-processed" beryllium copper springs. You can prove these statements to your own satisfaction without obligation by sending samples or drawings to our engineering department.

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DEPT. M, LITTLE FALLS, NEW JERSEY

"MICRO ... PROCESSED" I-S BERYLLIUM COPPER SPRINGS

New Zone of Destruction

A new Super Fuel will create!

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Just as fast as American refineries can get into production of a sensational new aviation gasoline—*United Nations' bomber fleets will be given a far wider cruising range for their blows at Axis Europe!*

So powerful it can't be measured by the present 100 Octane yardstick—this new super fuel was born in a Socony-Vacuum laboratory — the result of two great petroleum advances—Socony-Vacuum's new TCC Process—and a sensational new Bead Catalyst!

Its extra power, which we call *Flying Horsepower*—will not only permit wider bombing range—but will give a new maneuverability, speed, climbing power and carrying capacity to war planes. It's one of the keys to continued Allied air supremacy!

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MANY PRODUCTION INNOVATIONS IN FORD P&W ENGINE PLANT

FRANKLIN M. RECK
Detroit Editor

● On the office wall of one of the superintendents at Dearborn, where the Ford Motor Company's expanded production of Pratt & Whitney 2000-hp engines is now in full swing, are charts listing the thousands of new machine tools on order, by means of which the company's airplane engine production is soon to be doubled. Some four-fifths of the machine tools on order are standard, the rest are special-purpose. This tendency to create special-purpose machines to do a special production job at record speed is one of the tricks that lies behind the production records that are being hung up these days.

Ford is keeping up its present output scale in spite of a complete revision of its engine-plant layout. Much of the parts manufacture for the new schedules will be farmed out to the company's plants at St. Paul, Kansas City, and Highland Park. As one goes through the Dearborn factory, which is focal point for the engine production program, he sees many shipping boxes containing machines that are being sent to these auxiliary plants. Production delays are being avoided, meanwhile, by laying up a store of parts before dismantling machines and shipping them. Furthermore, only a part of the machines are being shipped out at any one time. These machines must be in operation in their new locations before more are shipped, thereby assuring the continued flow of parts to the assembly line.

Two Assembly Lines to Be Added

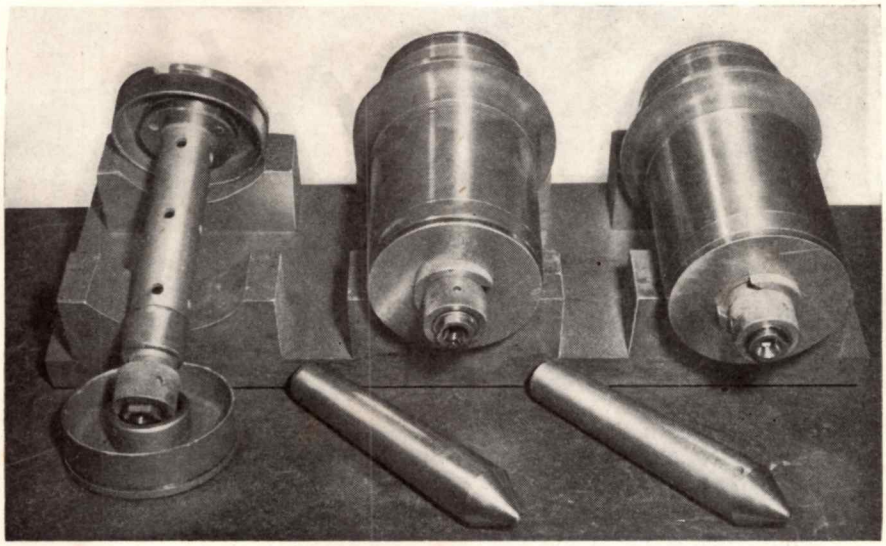
As departments move out of the Dearborn plant and space becomes available, the company will establish three engine assembly lines instead of

Green assembly line for the Ford 2000-hp Pratt & Whitney engine at the Dearborn plant. Swung in sturdily based cradles, engines tip at all angles for ease in adding parts

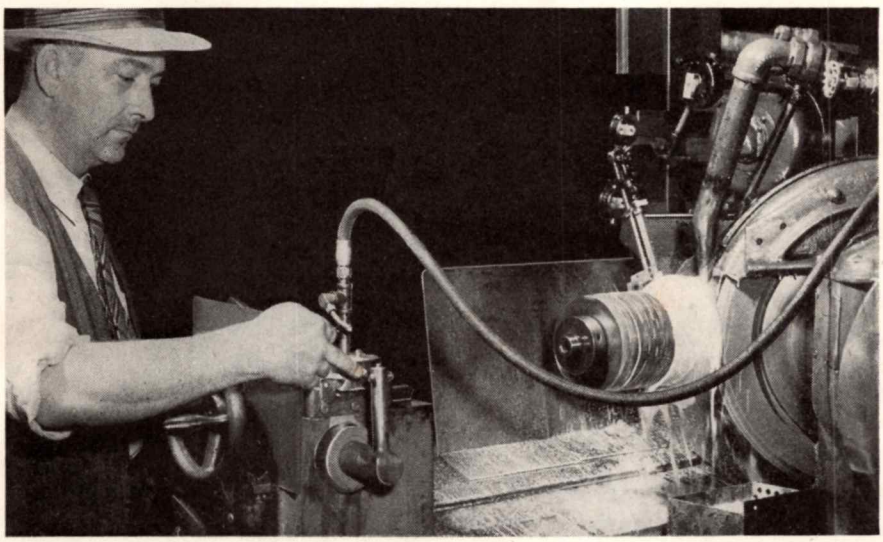
one, and will rearrange departments for a more perfect and continuous flow of work toward the final product.

Production speedups and Ford-designed fixtures and machines are in evidence everywhere throughout the Dearborn plant. One good example is the profile grinder by means of which several surfaces of different height on the crankcase end of the cylinder are ground on one machine at one time.

This grinder has a special dressing attachment mounted on the bed of the machine. When the wheel needs to be dressed, the diamond point moves across its surface guided by a cam that duplicates the profile of the cylinder. As many as fifty cylinders can be ground without redressing. These



Cylinder heads and parts of water cooled arbor



Triple duty grinder replaces nine machines and as many men

attachments eliminate nine machines and as many operators.

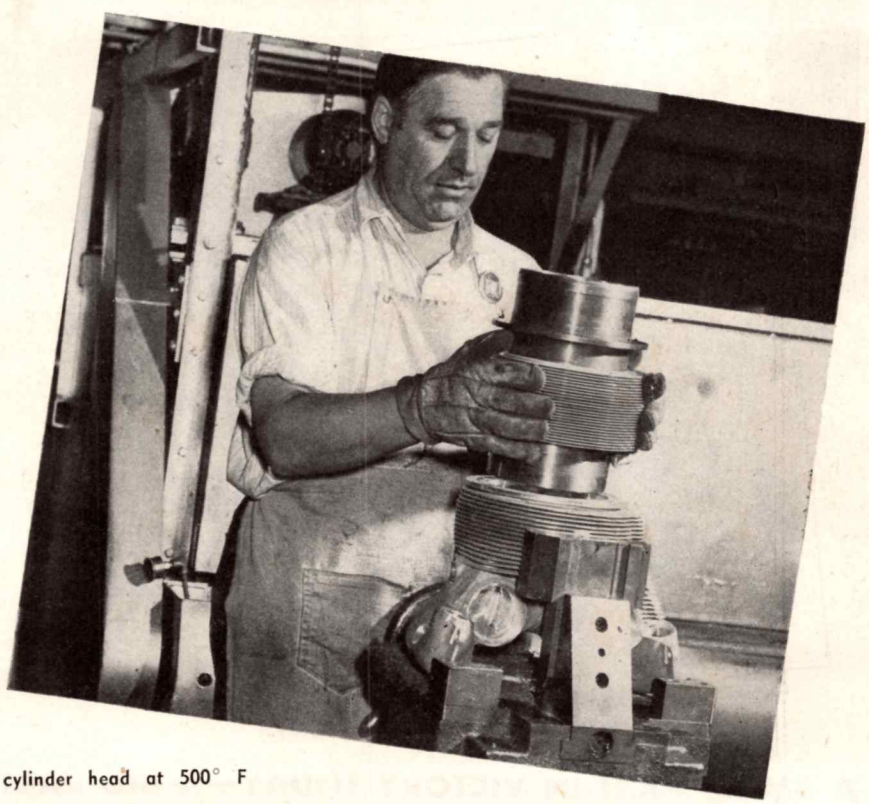
When it comes to grinding the other end of the cylinder—the muff diameter—a 6-in wheel is used instead of the original 3-in wheel. Use of the wider wheel eliminates the necessity of traveling it back and forth over the surface to be ground, and saves some 50% in operating time.

In connection with this operation the Ford water-cooled arbor is employed. This is a large hollow arbor into which the coolant is forced under just enough pressure to keep the barrel full. Before the cylinder is taken off the arbor it is sent by conveyor to the thread grinder. Here the thread is ground with one pass, instead of using four to six passes as was previously done, thereby saving some 60 percent of the former operating time.

For overall manufacturing ingenuity the paint department ranks high. Here a belt conveyor moves at slow speed toward the paint spray booths and along each side of the conveyor men and women workers are busy masking portions of the various parts. At one time a considerable amount of tape was required to mask the necessary surfaces. Then, because there was no precedent to follow in masking operations, a tool crib was set up nearby and workers were permitted to build their own masking devices.

The products of their ingenuity are now evident. A crankcase rear section comes along the conveyor and a workman puts on a single fixture contain-

(*Continued on page* 259)



Cold assembly is screwed into cylinder head at 500° F

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On the job doing their duty all the time—that's the reputation of Tobe Capacitors, earned through an almost complete absence of "returns!"

This record, far from making Tobe engineers complacent, acts as a spur to even higher quality, through constant research in materials and methods. Each Tobe Capacitor continues to be rated with ultra-conservatism.

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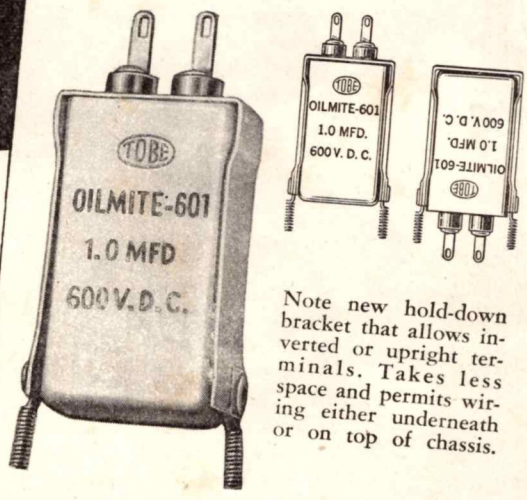

Note new hold-down bracket that allows inverted or upright terminals. Takes less space and permits wiring either underneath or on top of chassis.

CHARACTERISTICS OF TOBE OIL-MITE CAPACITORS

STANDARD CAPACITY TOLERANCE.	±10%
TEST VOLTAGE	Twice D.C. rating
SHUNT RESISTANCE.	.05 to 0.1 mfd. 20,000 megohms. .25 to 0.5 mfd. 12,000 megohms. 1.0 to 2.0 mfd. 12,000 megohms
RATINGS	.05 mfd. to 2.0 mfd. 600 V.D.C. .05 mfd. to 1.0 mfd. 1,000 V.D.C.
GROUND TEST	2,500 Volts D.C.
POWER FACTOR	At 1,000 cycles—.002 to .005

TOBE DEUTSCHMANN CORP.
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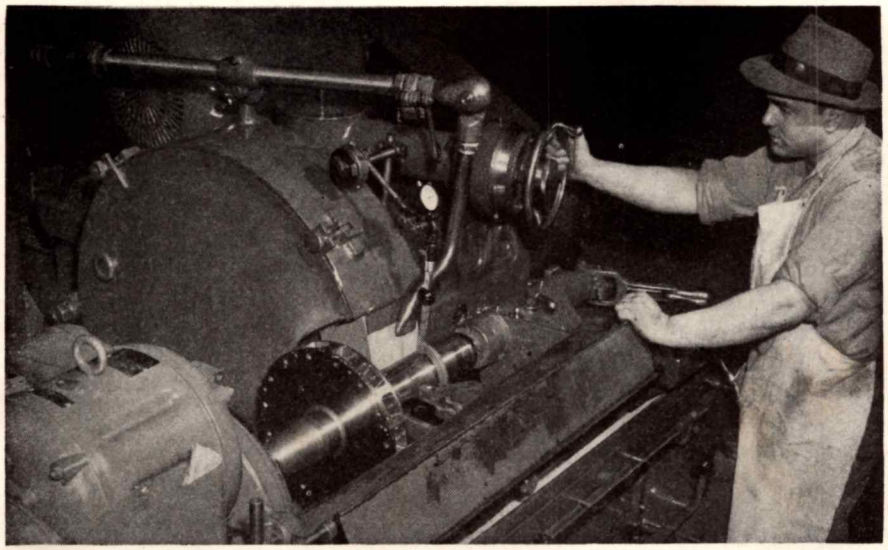
A SMALL PART IN VICTORY TODAY—A BIG PART IN INDUSTRY TOMORROW



Speed-up device grinds two bearing diameters on propeller in one operation

tunnel which utilizes room-temperature air in a forced draft over the parts. By means of this tunnel, cooling time is reduced to 23 minutes as against several hours by other methods.

Another special device is a conveyor hook for the heavy aluminum power section of the crankcase. Previously it was necessary to lift this piece off the hook and place it on the belt conveyor in order to mask it. Now the part is mounted on a pivot enabling the worker to spin it to any position, with the result that it can be masked without removing it from its hook. Women are now used to work on this part, where formerly only men were able to handle it.

Noteworthy, too, is the cabinet that has been developed here for refrigeration of valve guide inserts. It has a row of eight tube openings across the front, corresponding to the eight different types of inserts. To deliver an insert from the machine it is necessary to put a fresh one into the proper tube. The refrigerant is liquid oxygen, which gives a temperature of about –300° F. The engine parts are reduced to as near this temperature as is possible.

(*Continued from page* 257)

ing ten plugs, where formerly they had to be put in place one by one.

The two infra-red drying ovens, by means of which painted and enameled parts are now baked in 15 minutes (instead of the 1½ to 2 hours required by a gas oven), are also company-designed. No lead melts out of the light bulb sockets because the sockets extend to a bar along the outside of the oven, and are air-cooled. Inside the oven, the infra-red lamp reflectors are adjustable so that they can be moved toward or away from the parts being baked. It is possible also to turn off certain units in order to control the heat distribution.

After painting and baking, parts travel by conveyor through a cooling

Masking parts on conveyor running to paint spray booths

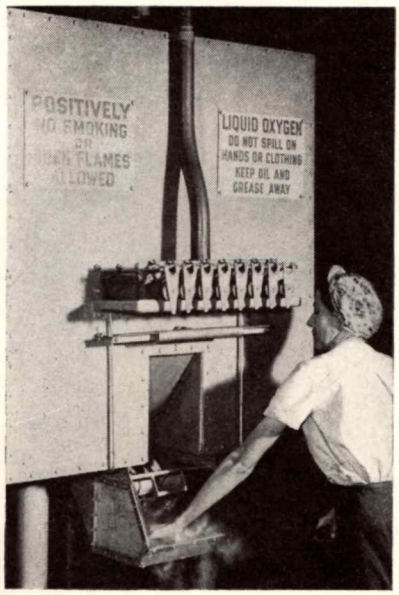
Fixture inserts ten mask plugs simultaneously

Multiple Operations

Everywhere throughout the plant are multiple-spindle and double-end machines for the simultaneous performance of multiple operations. For example: an 8-spindle Bullard is used for boring flyweight holes in the crankshaft counterweight; and a 6-spindle drill for boring rivet holes. A double-end boring machine is employed to line bore and tap bolt holes, instead of

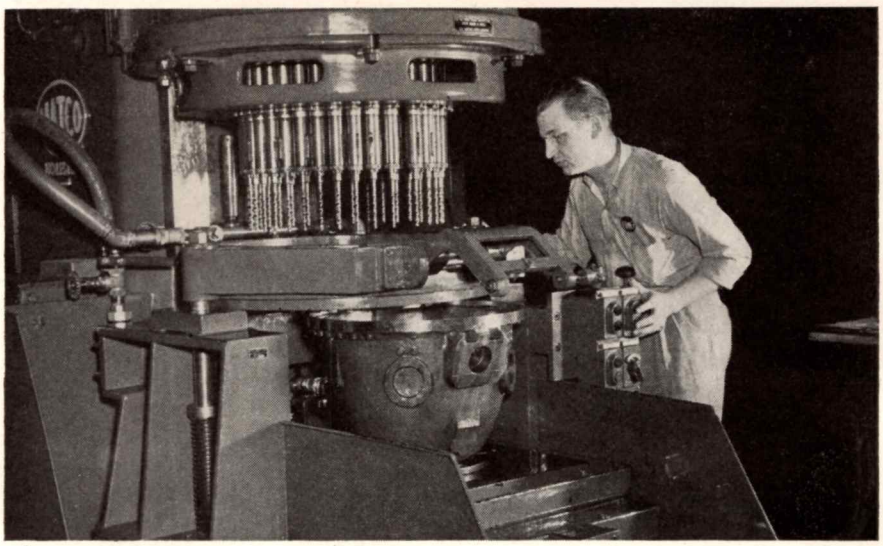
a radial drill. One special drill performs fourteen operations on the center section of the crankshaft, working from both sides. Wherever possible, operations have been combined and speeded up through the use of many-spindled machines. These machines, costing more in the beginning, soon pay for themselves.

To avoid distortion of parts in the quenching process after carburizing, use is made of quenching presses and dies. For example, a cluster gear is inserted in a die and held in place under pressure during quenching. In another case the crankshaft cheeks are inserted in a quenching press, with the result that there is no warping to be corrected afterwards.



Liquid oxygen in cabinet cools valve guides to —300° F

In cooperation with other airplane engine makers, Ford is exploring the possibilities of tumbling and shotblasting as time savers. The company is now shotblasting certain tank engine parts. Whether it will also shotblast P & W parts depends largely on the results of cooperative experiments now going on among the various engine manufacturers. At present many parts are being tumbled, with a saving of at least 50% of time over hand burring and polishing.



Much time is saved in manufacture of nose piece by this multiple spindle drill press

Advantages of Tumbling

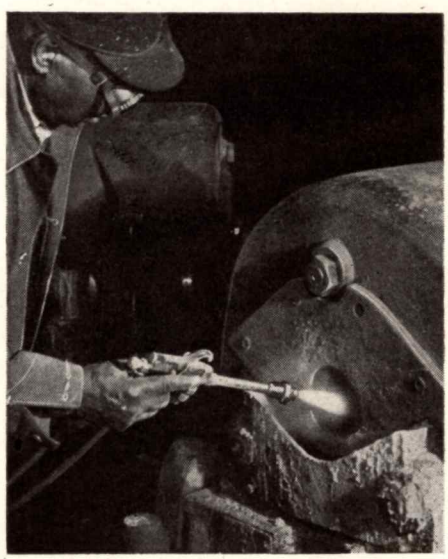
After the tumbling operation the part doesn't look as good as it did before. The "shine" is gone. But if the part is examined under the profilometer, it will be found that the surface has actually been improved. Furthermore, not a butt nor a sharp edge will be found on a tumbled part.

Publicity has already been given the Ford practice of centrifugally casting P & W cylinders. For some years, the company had centrifugally cast certain of its automobile engine parts. Since late 1941 it has been doing the same with aircraft engine cylinders.

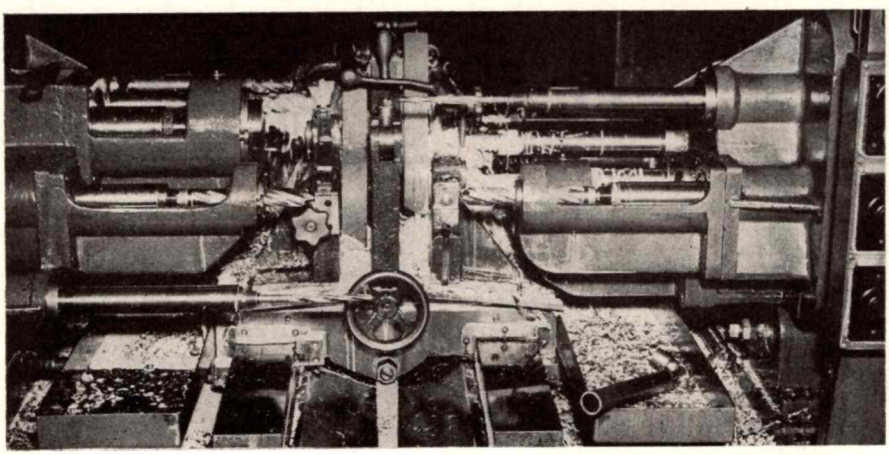
This operation takes place in the foundry on two turntables, around the circumference of which the barrel-shaped molds are mounted. As the mold reaches a certain station, a worker applies a spray to prevent metal from sticking to the interior surfaces of the mold. At the next stage the metal is poured into the rapidly spinning mold. Farther on, the cylinder is removed, a number is stamped on it and the cylinder is weighed.

The advantage of centrifugal casting over conventional forging is that only as much metal is put into the mold as is needed. To forge a cylinder there must be 72 lb of metal to begin with, much of which goes into the flash and other waste products of forging. In the case of centrifugal casting, on the other hand, only 40 lb of metal are used for this part. In the case of the centrifugally-cast barrel, rough turning of the outer diameter is eliminated.

These methods all add up to one thing: increased production without the sacrifice of quality.



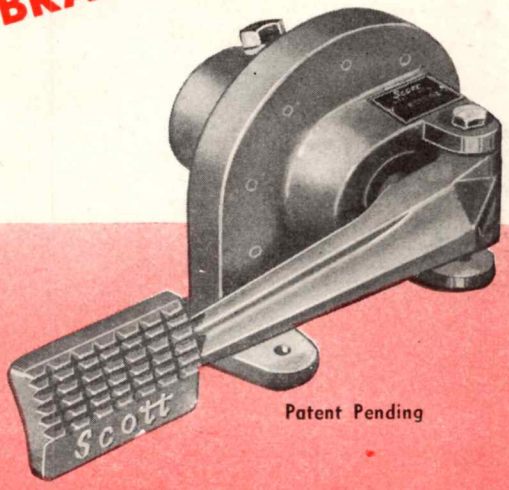
▲ Above: Spraying molds in which engine parts are cast centrifugally



◀ Left: This multiple-spindle machine performs six operations on the crankshaft

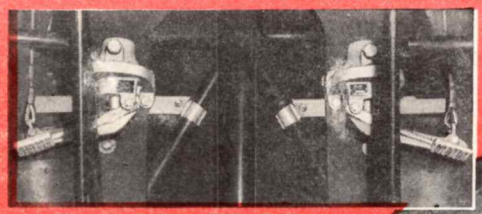
IT'S SMOOTHER, SURER STOPS WITH THE NEW SCOTT "B-711" BRAKE PRESSURE UNIT

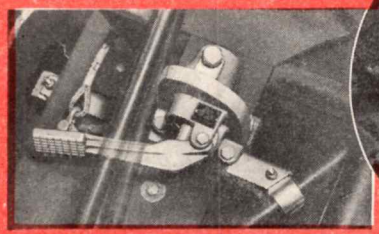
There's a real feeling of confidence when your heels engage the pedals of the newly-developed Scott Brake Pressure Units. You ***know*** you come to a smooth, safe stop when and where you want to. That's because these new hydraulic pressure cylinders are positive in action—absolutely fluid-tight—assuring top efficiency from the brake system. Designed for use on light aircraft using the expander tube brakes, these units may be adapted to other braking systems. Readily installed, and located with pedals in conventional relationship to the rudder pedal. Scott B-711 Brake Pressure Units are simple in design, durably constructed, light in weight (only 21 ounces). Each unit is exactingly tested to assure dependable, long-term performance. Economically priced. Write for illustrated folder.

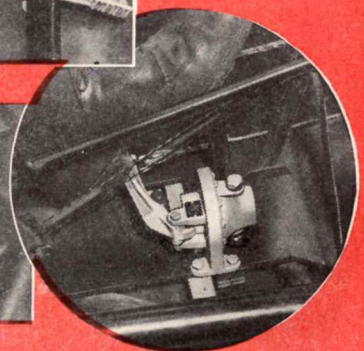


Patent Pending

The illustrations below show the locating and simple method of installing the pressure unit in the brake system: (1) Installation on Piper J-3 with floorboards removed showing method of reinforcing and attachment to structural members of fuselage. (2) Close up of left-side pressure unit showing cable extension to front seat brake pedal and attaching clamps. (3) Convenient arrangement of pressure unit pedal, located for easy, positive operation.







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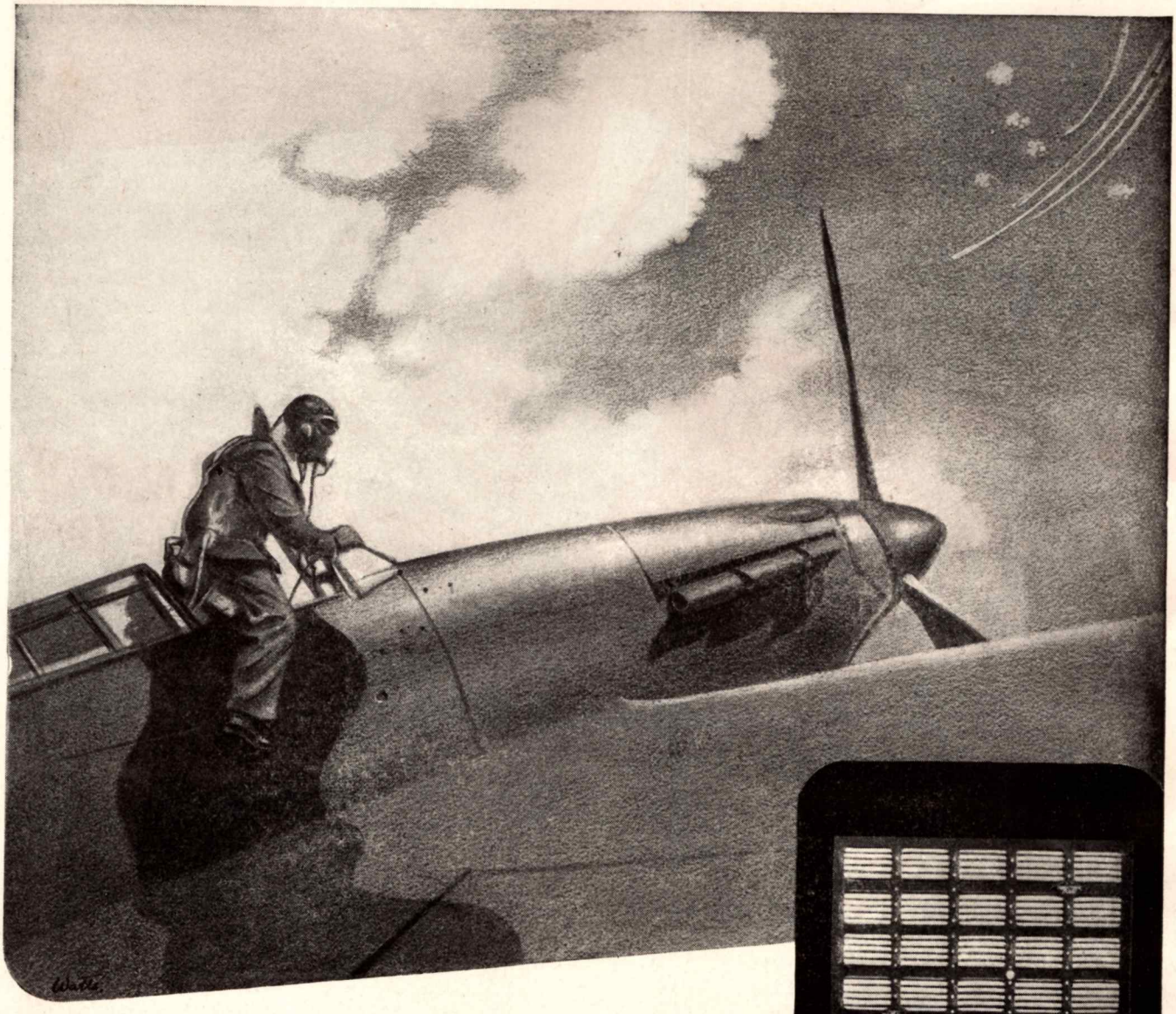

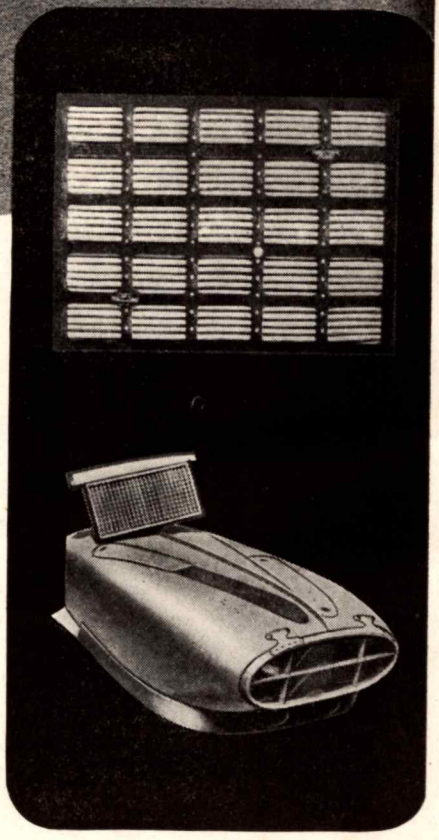

THERE are many other aspects of battle than the clash of steel, artillery duels or fights to the finish in the air. Ask the engineers what it means to battle against the havoc wrought by torrential rains, hurricanes and those bitter enemies frost, ice and snow.

There are yet other enemies to be conquered — dust and, especially in the North African and eastern battle areas, SAND — the relentless fighter against efficiency of aircraft and mechanised units of the Army.

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WASHINGTON IN-FORMATION

(*Continued from page* 138)

all services—Army, Navy, and Air—under a Department of War which would be headed by a civilian. Under this civilian head, who would also be a member of the cabinet, there would be a military officer who would be chief of staff.

The chief of staff would control two divisions—operations and material. The operations division would be charged with the procurement of personnel, training for war of all branches of the armed services, and operations during war. In fact, the chief of the operations division would be commander in chief of all forces in time of war. Equally broad powers would be exercised by the material division proposed in the Yarnell plan. This division would be responsible for the design and procurement of material and supplies for all three branches of the service.

Under each of these two major divisions, Admiral Yarnell would have sections handling the special branches —Army, Navy and Air. Thus air power would be recognized in its own right and would not be placed in a subordinate position to the land or sea arms. There would be a single academy for the primary training of officers. It would provide basic training in mathematics, languages, engineering, military tactics, navigation, and aviation. All students would have to be qualified for solo flying before graduation. Upon graduation they would be assigned, preferably by their own choice, to the three branches of the service.

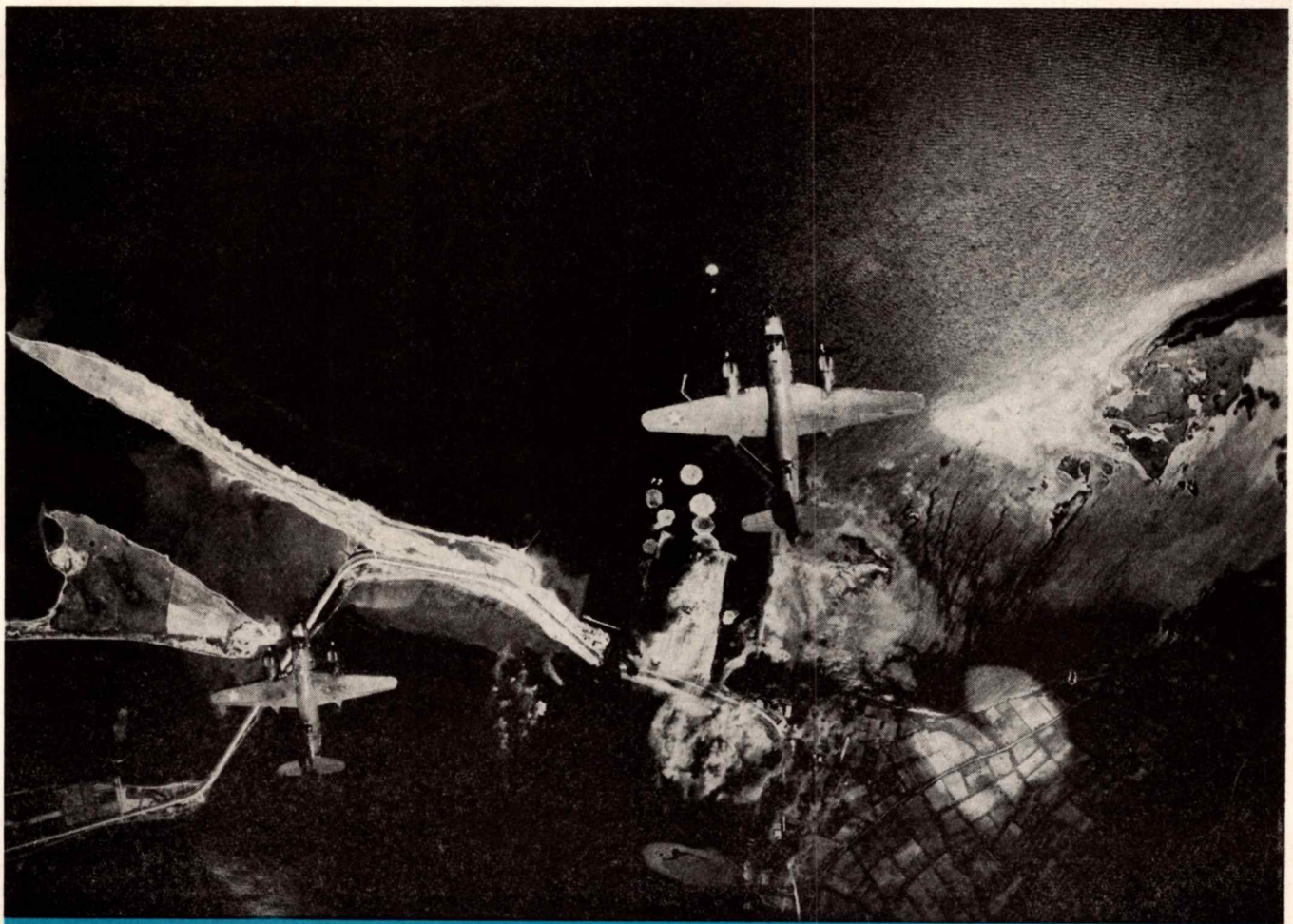
New demands for a unified service command are also being made on Capitol Hill. In a statement on the subject, Senator Carl A. Hatch (Dem., N. M.) expressed the hope that air power would soon be given equal rank with the other services in the President's war councils. While he believes that cooperation between the various branches is excellent, he is convinced that "we cannot rely upon cooperation alone." Short of setting up a Department of National Defense with air, land and sea branches he feels that an air chief having equal rating with Army and Navy staff heads would at least be a step in the right direction.

Thus AERO DIGEST's long fight for unified direction of our war effort, under a civilian Secretary of a Department of National Defense comes nearer to realization.

Navy Reshuffling Air Divisions

While reiterating his opposition to a separate air force, Secretary of the Navy Knox has nonetheless taken steps to intensify the fleet's air activities. The five major aviation divisions are being reshuffled. In fact, these shifts are the second chapter in a major reorganization that began in July with the promotion of then Rear Admiral John Sidney McCain to fill the newly created post of deputy chief of naval operations for air with the rank of vice-admiral. His old job as chief of the Bureau of Aeronautics was taken over by Rear Admiral Dewitt Clinton Ramsey. Both have seen war duty in the south Pacific.

The latest shifts are designed to give Admiral McCain the operating functions which had been in the Bureau of Aeronautics. Thus the Bureau will confine its activities to the material end. The transfer affects the training.



Martin "Marauders" in action: these medium bombers are here photographed smashing a causeway and a military installation somewhere in North Africa. They have been extremely active in the Mediterranean theater

planning, personnel, flight and air information divisions. Altogether some 40 percent of the officer personnel of the Bureau of Aeronautics will go to Admiral McCain's organization. In discussing the new organization, Secretary Knox stated that "aviation has grown so big" that the functions being transferred can "better be handled outside a material bureau."

Grasshoppers Gaining

That grasshoppers are gradually winning a place for themselves as spotters for the artillery, is conclusively established by reports filtering in from the Mediterranean theatre. Light planes of this type proved their worth during the last days of the Tunisian campaign, according to these reports. It was found that they could not only make accurate corrections on targets from fairly low altitudes—600 feet is the prescribed ceiling—but that they also could successfully elude attacking enemy planes. The training course given the pilots has been graphically illustrated by Colonel William Wallace Ford who pioneered the use of these planes for the Army. "We just take what the CAA says don't do—and do it," is the way he put it. This includes taking-off from rock-strewn flying strips and clearing 50 foot obstacles in 400 feet, as well as landing under next to impossible conditions.

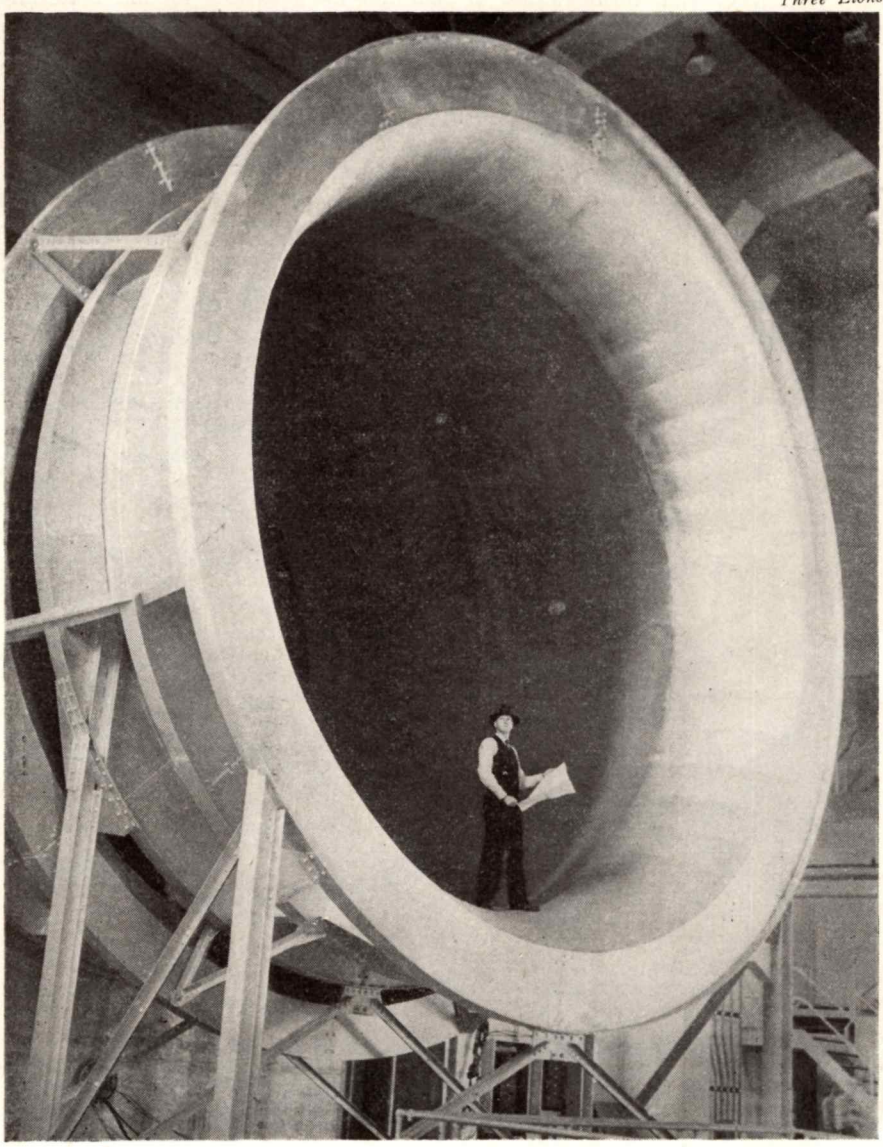
To Process Latin American Applications

Along with other developments, concerning the formulation of plans and policies for international air operations after the war, comes the interesting disclosure that the CAB may decide to start processing applications for Caribbean and Central and South American routes by domestic airlines, without waiting for hostilities to cease. Previously, the CAB has taken the position that foreign operations are still too enshrouded with uncertainties to permit applications to be unfrozen at this time although some months ago it announced that it would start hearing applications for domestic operations again. If the report proves correct, Capital air circles regard it as a logical move. It is felt that the situation is quite different with respect to our Latin American neighbors than the foreign outlook generally; that these countries are much better able to discuss negotiations for air service at the present time than most of the rest of the war-torn world.

It is also indicated that the State Department intends to issue a pronouncement in the near future making it clear that the government will be the sole negotiating agency for landing rights in foreign countries. The obvious purpose is to end the practice of private corporations making their own deals with foreign governments. The State Department is in fact emerging as the dominant agency in regard to international air policy and the Berle Interdepartmental Committee seems to be slated to become a research and advisory agency.

The 20-ft diameter stainless steel mouth of the 400 mph wind tunnel at Wright Field. It is large enough to test full-size fuselages and wing sections, and complete 15-ft aircraft models. The main power unit is a Westinghouse 40,000 hp variable speed induction motor

Three Lions



"Personal Airplane" Promotion

Prior to formal action by its board of governors, the Aeronautical Chamber of Commerce has not yet taken a stand on the proposal for the setting up of a "Personal Aircraft Manufacturers Section." This proposal grew out of a meeting of a group of manufacturers of family type airplanes that was held in Chicago early in August. There are indications, however, that the idea is not looked on with too much favor. The question is asked: "Why create a special committee to promote a cause that is of vital interest to every aircraft manufacturer regardless of whether or not he has produced light planes in the past?"

To state it differently, the impression is obtained from ACC sources that the development and promotion of small planes for private flying is a matter of the utmost concern to the whole aviation industry including companies making accessories. Thus it is felt that steps to popularize this type of aircraft should be taken on an industry basis and not by a subcommittee representing only some of the manufacturers. On the other hand, there is no intention to dispute the need for a promotional program. In fact the view has been expressed in some Washington air circles that the time has come to prod the CAA into undertaking certain basic research projects that will make personal planes more acceptable, such as the development of an inexpensive but adequate instrument panel.

Answering the call for Magnesium Alloys

Twenty-seven years of research and experience go into every Dowmetal magnesium alloy ingot so that you who are entrusted to make vital sand, permanent mold and die castings can forget your alloy problems when you buy ingot from Dow.

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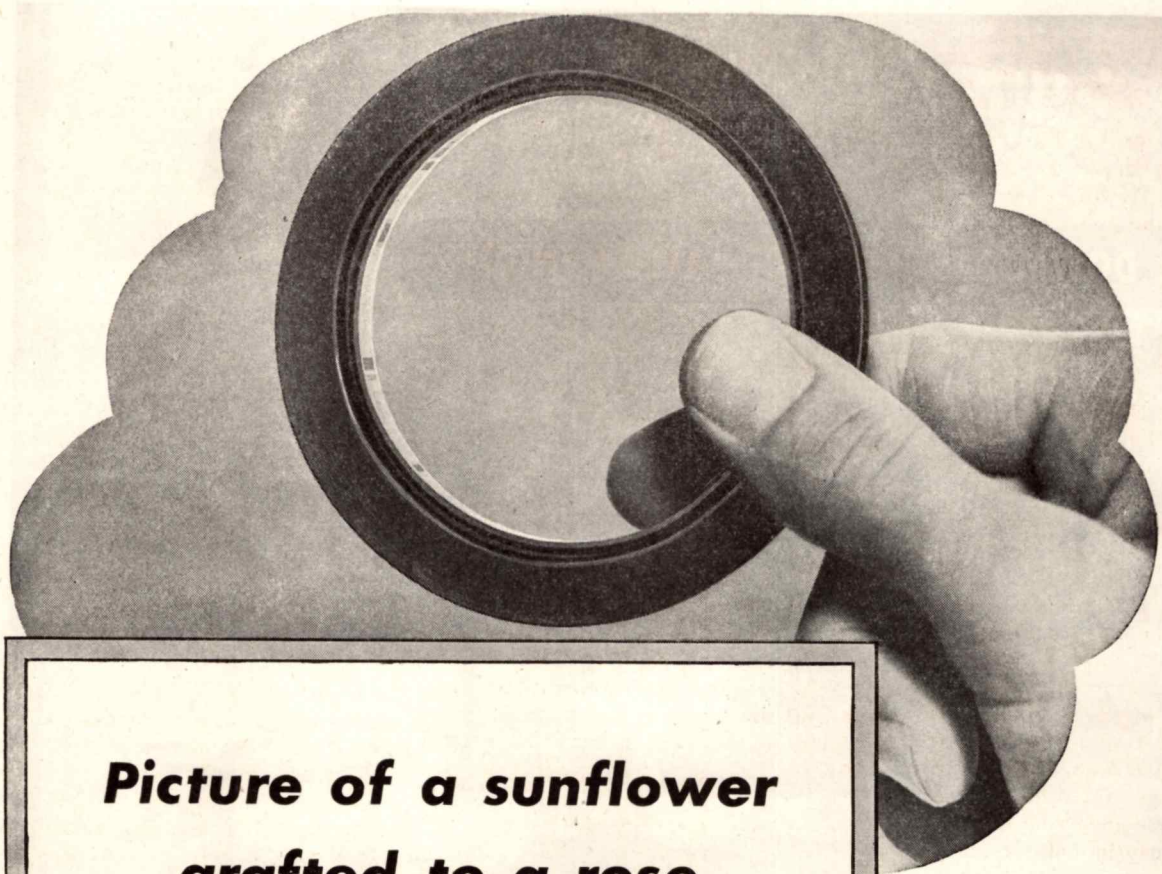


Picture of a sunflower grafted to a rose

ILLUSTRATED here is a metal-insert hydraulic seal for aircraft use. The metal was carefully and precisely machined to extremely close tolerances.

But whatever was gained by accurate machining was promptly thrown away, for they bonded to it a resilient material that swells as much as 10% or 15% in hydraulic oil.

It's like grafting a sunflower to a rose.

For fine, close-tolerance performance in resilient materials, engineers in vital war industries are specifying Hycar synthetic rubbers. Why? Because Hycar can be tailored to the job. Oil-swell can be limited to plus or minus 1%, or even held to zero. In addition, Hycar can withstand temperatures of 250°, abrasion resistance is 50% in excess of natural rubber, and compression-set characteristics are excellent.

Hycar is light—20% to 25% lighter than many other synthetics. And its resistance to oil absorption keeps it light.

Aren't these the qualities you have wanted in oil and fuel hose, hydraulic lines, seals, gaskets, grommets, diaphragms and other resilient products you use? *Hycar Chemical Company, Akron, Ohio.*

Hycar is supplied in crude form to rubber fabricators. Because of its outstanding performance in war uses the demand far exceeds the supply. But now is the time to work out with your supplier of rubber products ways of obtaining Hycar for actual test in your own applications, both present and future. It's to your advantage to gain experience now against the day you will need new and even better rubber products. Our technical staff and laboratory are ready to help.

Hycar

LARGEST INDEPENDENT PRODUCER OF BUTADIENE SYNTHETIC RUBBER IN AMERICA

QUALITY WITH QUANTITY

(*Continued from page* 181)

sults, the easing up, the slackening of vitally-needed production, which accompanies this feeling. And why shouldn't it? If the game is over, why keep on playing?

I don't know what the figure for this war will be, but I do remember that in World War I, in the last hour of conflict, in that last sixty minutes during which everyone knew it was all over as soon as the clock reached the designated time, that more than one thousand men were killed in battle. And that, of course, is the reason why there can be no letup today or any day, but rather only increased effort until the last shell is fired.

Add to that dangerous slowdown feeling which today is growing, the alarming turnover and absentee figures, and you have production problems which are tough. Tough enough certainly to offset some of the other problems which we've managed to lick.

Those problems and others equally serious must be considered as inevitable but not insurmountable during this time of emergency. Our industry hasn't yet whimpered about how hard its job is and I doubt if we're going to start now.

But we've been so absorbed with the mastering of our problems, big and little, that it's all too easy for us to forget our biggest present problem, the one I've been talking about—*quality*, constantly improving quality. We know we can build planes in required volume. Our main task now is to make them outstanding in quality of design and quality of workmanship.

"VISUALS" SAVE TIME

(*Continued from page* 207)

conservative to state that perspective, or three-dimensional drawings can be shaded by this method in less than one-fourth the time needed for hand shading, and with greatly superior results.

Another interesting feature of these drawing papers is that they can be had in light weights, transparent enough to "shoot through" in making direct-contact blueprints.

Three-dimensional visuals are coming into wide use in aircraft plants in four basic fields. One is the making of preliminary sketches in the engineering department for discussion and approval by engineers and management. In the first place, such sketches expedite decisions because of their lifelike nature. Design errors or necessary changes can be detected more easily on three-dimensional drawings than on standard orthographic projections. Secondly, they make possible the break down of manufacturing procedure into its various operations—the workers being supplied with drawings which give them an accurate picture of the work they are doing. The third important use for visuals is in the manufacture of sub-assemblies. A fourth use is in operational manuals, which may be either instruction booklets, parts lists or handbooks devoted to constructional details.

Any good commercial artist can quickly adapt himself to making visuals. The same is true of mechanical draftsmen. Accuracy is required in the same degree as in making regular mechanical drawings. It is safe to assume that in a couple of hours any experienced artist, whether of the commercial or the mechanical type, can familiarize himself with the technique. It is simply a matter of applying a developer to the drawing in the proper way to bring out the shading which produces the three-dimensional effect.

ANTI-ICING

(*Continued from page* 227)

eration of the engineering staff at Wright Field, this contrivance is designed to remove the threat of the loss of balance and of certain airscrew properties of propellers caused by ice formation.

A new product of U. S. Rubber, known as *Uskon*, makes this device possible. This material, through the addition of certain chemicals, is made to conduct electricity, in contrast to the usual insulating properties of ordinary rubber. A strip of conductive rubber is attached to the leading edge of each propeller blade. The passage of electricity through the material heats it sufficiently to keep ice from forming—an obvious advantage over methods which function only after the ice has already formed.

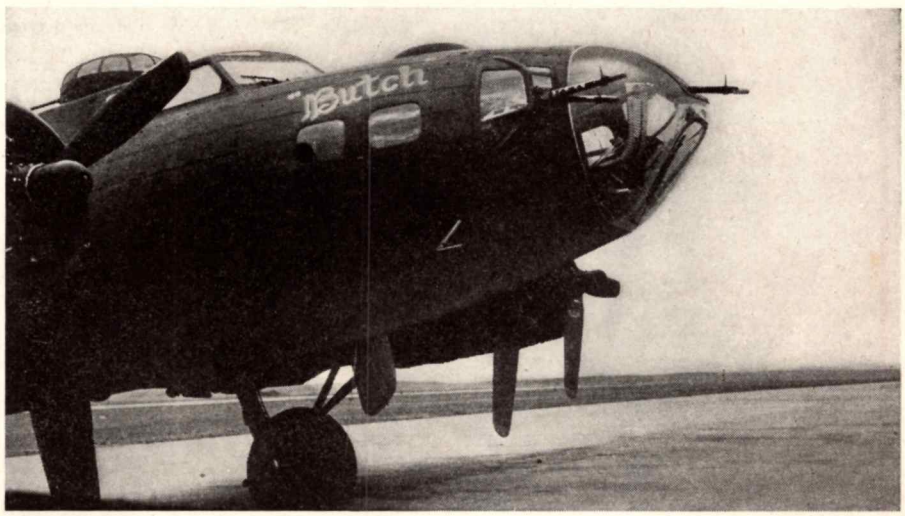
Test flights using the new material have been conducted by the staff at Wright Field and have established its merit. The NACA, still actively engaged in studying anti-icing problems, will carry on further experimentation with the conductive rubber unit. Goodyear and other rubber manufacturers are working along similar lines. It is expected that the principle used in the new propeller anti-icer will be applied to other ice-formation problems in military and civilian aircraft.

HAND-STONING

(*Continued from page* 201)

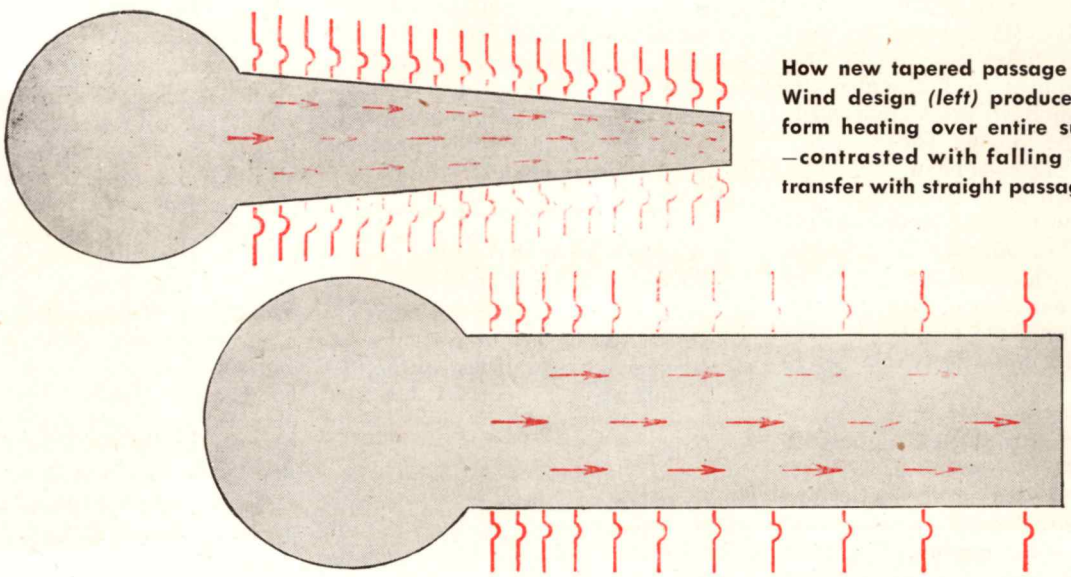
ting edges. One is typified by that made of Norton's electric furnace "Alundum" abrasive, brown in color. It is available in three grades: coarse, medium and fine, and should be applied in that order. This type of stone is necessarily oil-impregnated by the manufacturer. If not so treated, it would absorb instead of retaining on its surface, all later applications of oil. The other basic stone is Hard Arkansas, white in color, a natural stone mined in the Ozarks. This stone, available in only one grade — extremely fine—is to be reserved for the final step in the sharpening process.

A corollary advantage to be gained by hand stoning lies in the time saving made possible when a cutting tool treated by this method shows the first signs of dullness. By merely touching up the edges again with an oilstone, the tool can be used several times more before grinding becomes necessary.

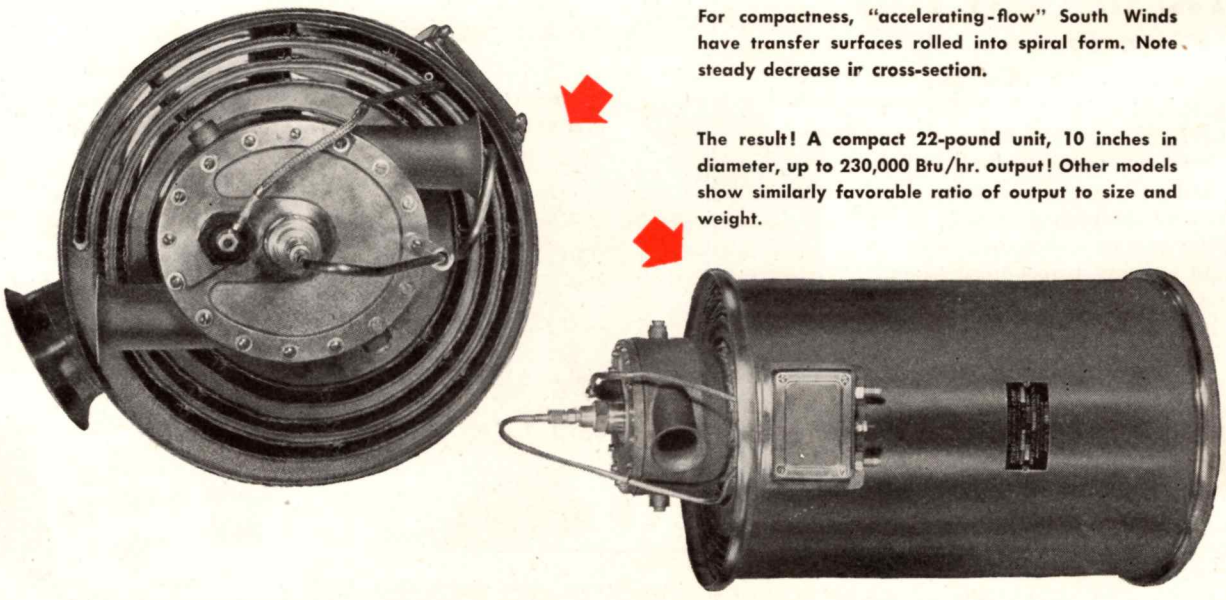


The "Fortress" gets 'discouragers' for those Nazi pilots who come in head-on to attack it. View shows the new frontal position of the .50 cal machine guns in the nose. The bomber now mounts 13 guns

New! Another development



How new tapered passage South Wind design *(left)* produces uniform heating over entire surface—contrasted with falling off in transfer with straight passage.



For compactness, "accelerating-flow" South Winds have transfer surfaces rolled into spiral form. Note steady decrease in cross-section.

The result! A compact 22-pound unit, 10 inches in diameter, up to 230,000 Btu/hr. output! Other models show similarly favorable ratio of output to size and weight.

basic heating by South Wind!

New "accelerating flow" design delivers even greater volume of heat ...cuts bulk and weight!

AGAIN Stewart-Warner South Wind Heater engineers have originated a major contribution to heating science! A development which for the first time makes every inch and pound of heating surface operate at full efficiency.

Throughout history, combustion devices have been limited in their output by the critical temperature of the metal most exposed to heated gases—while remoter surfaces operated at as little as 20% of maximum safe limits.

Now—by design which forces steady acceleration of combustion gases, South Wind engineers attain uniform heat-transfer coefficient *over the whole surface*. While most-exposed areas are held within critical limits, a new *spiral* design forces more remote surfaces to "scrub" more and more heat from escaping gases.

Thus the most remote transfer surface is stepped up to full utilization. And heat output per unit of surface reaches new record level while weight and bulk of heating units are still further reduced.

• • •

While the implications of this new development extend to every heating field, its present importance is in meeting aviation heating needs.

Ever since aviation experts set out to give American combat planes their present record ceilings, South Wind engineers have been privileged to cooperate closely on the new heating problems encountered, and to contribute by developing better heating from lighter, more compact units.

With the development of this new South Wind design, and the resulting increase in heat-transfer efficiency, South Wind is again able to offer stepped-up heat output from even smaller sources.

For example—up to 230,000 Btu/hr. output from a South Wind only 10 inches in diameter—15 inches long before adding duct connections—and weighing only 22 pounds!

ARMY E NAVY

South Wind
REG. U. S. PAT. OFF.

HEATING EQUIPMENT

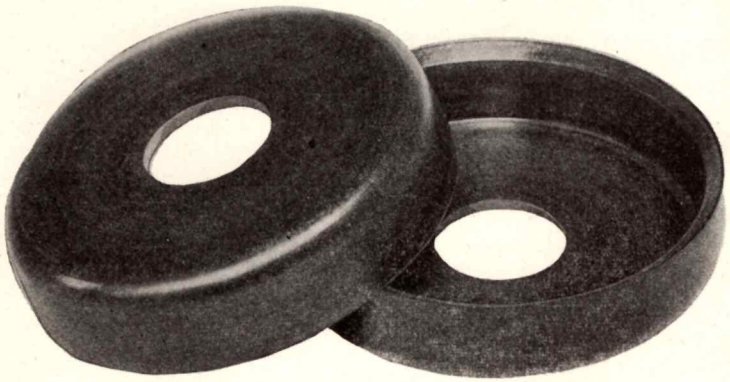
Heater Division, Stewart-Warner Corporation, Chicago
West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service
1273 Westwood Blvd., West Los Angeles, California

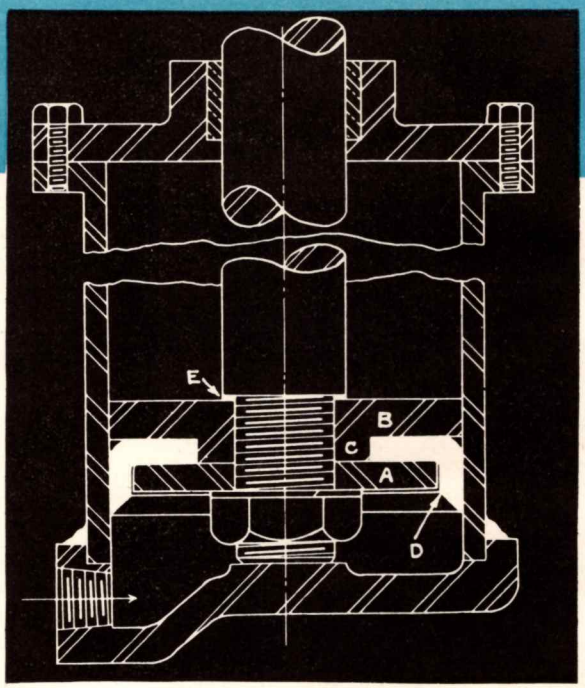
Another Product of STEWART WARNER

GRATON & KNIGHT ENGINEERS *Present* PACKINGS POINTERS

No. 1 in a series of articles discussing the fundamentals of packings design and application. The first four articles will deal briefly with the four common packing types. Other phases of selection and application will be discussed later.

Reprints of each article will be available, free. If you would like to make a collection, please write to Packings Department, Graton & Knight, Worcester 4, Mass.





CUP PACKING — DESIGN FEATURES

A — Follower plate. B — Backing plate. C — Hub of backing plate. D — Bevel of cup packing. E — Gasket.

THE CUP PACKING—The cup is the most common packing type. Its sealing surface is at its outside periphery.

The cup has only one application—on a piston head. The piston may be reciprocating in a stationary cylinder or stationary in a reciprocating cylinder (in rare cases, either may rotate). Common applications include hydraulic or pneumatic operating cylinders such as pumps, presses, air engines, hoists.

Usually, the seal between the bottom of the cup and the piston head is a *compression* seal, created by bolting the cup between the piston head (or backing plate) and a follower plate. The seal between the cup wall and the cylinder is provided by the pressure applied to or created by the cup.

MAIN ADVANTAGES—1. Simpler and easier to install than a U packing or a set of Vee packings. **2.** Less machining required. **3.** Lower initial cost.

BACKING PLATE

1. Should be designed to provide a sliding fit in the cylinder. The closer the fit, the longer the packing life. Excessive clearance invites extrusion of packing, resulting in breakdown at heel.
2. Hub should be 1/8 or 1/4 less in height than thickness of the cup packing (depending on hardness or thickness of material). This will allow for sufficient compression of the bottom of the cup to create the seal between packing and piston head. The hub itself prevents *excessive* compression which would spread the packing.
3. On larger installations, fluting of the packing plate is desirable in order to assist in compression sealing and to prevent spreading of the packing. Fluting is essential in the absence of a hub.

World's Largest Industrial Leather Plant

GRATON & KNIGHT *Engineering*

FOLLOWER PLATE

1. Should be thick enough to reach the bottom of the bevel of the cup.
2. Clearance between the follower plate and the inside wall of the cup should be about 1/3 the thickness of the packing in order to prevent binding.
3. Fluting will hold the packing firmly, assist compression, and prevent flow.

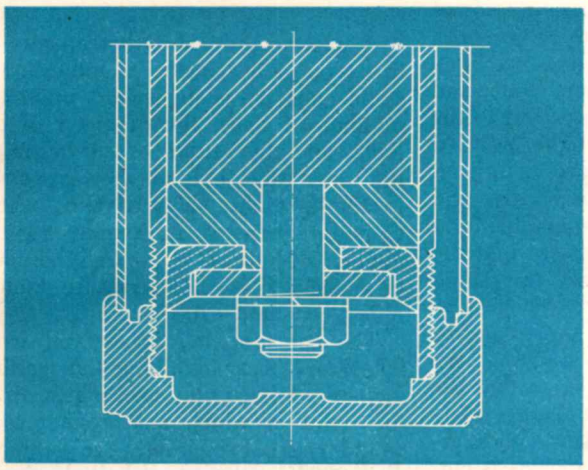
BOLT HOLES. On large cups, it is desirable to have several equally-spaced bolt holes.

GASKETS. Where the piston head is bolted to the piston rod or where the bolt holes pass completely through the piston head, it is desirable to use gaskets between metal surfaces.

EXPANDERS

1. Recommended to keep packing walls in contact with the cylinder, thus insuring an initial seal when pressure comes on:
   a. where the pressure is low
   b. where the pressure is gradually built up from low
   c. on horizontal cylinders
2. Expander Types
   a. *finger-type* — best but most expensive
   b. *coil spring* — usually satisfactory; less expensive
   c. *snap ring* — more easily adapted to large jobs; least expensive
   d. *clock spring* — for delicate action, uniform tension all around (can be used in combination with a felt lubricating strip)

GRATON & KNIGHT Recommendations at the "Packing Point"



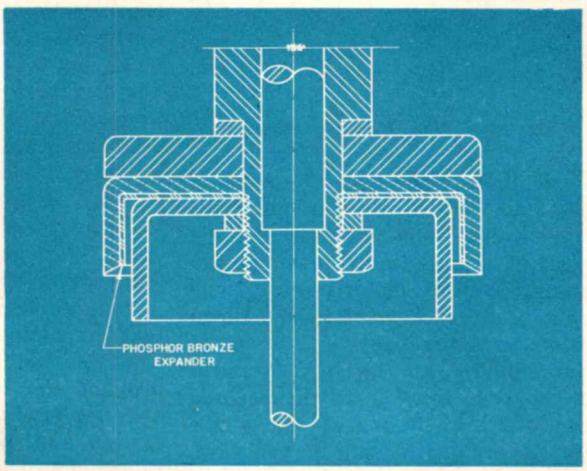
Case No. 1. Cup Packing, hydraulic application

Equipment: hydraulic jack.

Operating conditions: 5000 p s i . . . slow-moving plunger . . . intermittent operation . . . winter-summer use.

Equipment design: backing plate made to fit closely in the cylinder and give the cup good support . . . follower plate designed with proper clearance, permitting pressure to act upon the walls of cup.

Packing: Graton & Knight's Spartan Leather, treated for mineral oil at 5000 p s i; winter-summer operation.



Case No. 2. Cup Packing, pneumatic application

Equipment: sliding door engine.
Operating conditions: 50–125 p s i air pressure . . . rapidly-moving plunger . . . intermittent, but frequent operation . . . all atmospheric conditions.
Equipment design: accurate backing plate to prevent pinching heel of packing . . . special design of follower plate with extension to act as bumper . . . spring expander to insure instantaneous seal at low pressure.
Packing: Spartan leather impregnated to be air-tight at 125 p s i . . . flexible enough to be responsive to spring expander . . . firm enough not to bind in cylinder . . . impregnated with lubricant.

SPARTAN LEATHER PACKINGS AND A SERVICE THAT BUILDS CERTAINTY AT THE POINT OF SEAL

Graton & Knight's SPARTAN emphasizes the many advantages of leather as a packings material —

> wearing quality . . . low coefficient of friction ... flexibility at low temperatures . . . adaptability to wide range of mediums . . . economy

and adds the following qualities, which result from an exclusive "combination" tannage —

> the resistance to heat and oil of top-quality chrome leather . . . a mellowness and flexibility not found in the usual chrome tannage.

Spartan has highest resistance to heat (withstands boil test), and will not dry out hard and brittle. It is acknowledged the top-quality leather in the packings industry.

It's the combination of proper selection of sealing material plus correct application that has made Graton & Knight engineers the No. 1 source of practical, time-saving aid for machine designers.

When your design reaches the "packing point" — or when a packing trouble arises — call on G&K engineers.

the hand that builds certainty at the point of seal

GRATON & KNIGHT COMPANY

WORCESTER 4, MASSACHUSETTS

GRATON AND KNIGHT

FOREMAN—MANPOWER

(*Continued from page* 157)

so often thought of as a small cog in the production machine, deserves consideration, for, after all, he fills an important and necessary place. Cooperation with him, for one thing, means *knowing* that production inventory is within safe limits when the tearing down of a production set-up is undertaken. A last minute discovery that unusual demand or spoilage has melted away that safety margin can be avoided by conferring in advance with the stockman. This, incidentally, will make him feel that he really plays an important part in the smooth running of the organization.

The Man Who Wants a Raise

Then there is the man who wants a raise. The busy foreman is apt either to flatly refuse him or to promise the raise in an absent-minded fashion without investigating the record of the worker—only to have it turned down later on by the management.

But suppose the foreman were to take the time to look up the records himself and to find that the man's rating doesn't qualify him for the raise. He goes over the record with the applicant, showing him where his failings are and encouraging him to bring his record up to a point where the management cannot turn down his request. The applicant will thus have not only been made to understand why the raise cannot be immediate, but he will respect the man who has pointed out the reason why.

And then the man who is good only for the simplest kind of bench or machine job. He takes up the group leader's time and then turns out scrap that must be charged against the department. There is no time for training in the plant, and yet he is intelligent and could become a valuable man if only he could be taught shop practice.

The obvious answer is training school and, if the foreman explains to him the fundamental purpose of the school and the benefits both to him and to his employer in seeking this training. It's ten to one he will have developed an interest on the part of this slow worker that will reap a rich reward.

Consider now the case of that new machine, which suddenly appears in the department with no one qualified to run it. The wise foreman will always permit the employment office to cooperate with him in avoiding such difficulties. If he has set up his manpower specifications fully, perhaps with the aid of a job analyst, and has let the employment office know just what kind of man he will need when the new equipment arrives, there's a fair chance that by the time the machine is set up and ready for production they will have found an experienced man to run it.

The employment office has been organized largely for the very purpose of measuring the ability of each new worker and of keeping track of the progress of training school candidates. It is to the foreman's own interest to take advantage of this service rather than expose a production schedule to the risks inherent in a "cut and try" system.

Time study properly comes in for consideration whenever the operator of a machine complains that he can't make his time on a certain machine. Say that the foreman, group leader and time analyst gather round to get to the bottom of the trouble. The worried foreman, thinking of the production demanded of him, is apt to be disposed to believe that he needs another machine. The group leader sees that the tools are properly set and everything is running as it should, so he decides that the blame rests on the operator. But the time analyst, studying the problem as a whole, perceives that the operator is obliged to indulge in waste motion and, perhaps, that a poor arrangement of working materials is cutting down production. He makes the few changes necessary and production moves up to the required standards.

Cooperation with Fellow Foremen

Trading full cooperation with his workers and maintaining theirs and the management's confidence are not the full measure of the foreman's responsibilities. He owes loyalty and consideration to his fellow foremen. If, for instance, he leaves insufficient information concerning some set-up for the guidance of the foreman of the shift that follows his own, the inevitable result will be confusion, misunderstanding and even hard feeling. If a change in blueprints doesn't happen to affect the following shift, leaving a brief memo which fails to explain when the change is to be made may work out all right for that shift. But by the time the third shift arrives, that memo will be so baffling that the foreman may decide to shut down rather than take a chance on producing what may be so much scrap.

And so, with these guiding principles, on down through the plant, even to the gatekeepers. It's their job to see that nobody but authorized employees get through the gates, and the foreman can set the example and gain the cooperation of his workers by proudly displaying his badge when he comes on a shift.

Pratt & Whitney has proved to its own satisfaction that such foremanship training counts, that education in the value of cooperation and of the practical work-a-day application of a basic understanding of human relations pays big dividends.

BALL BEARINGS

(*Continued from page* 191)

Ball reciprocating bearings are often used to operate in an axial direction and in such cases a large number of axial paths exist. But the most common usage for this type of bearing is in combined reciprocation and rotation.

A general guide for the capacity of this type of bearing is as follows: the static capacity is dependent upon the number of balls, the diameter of the balls, and the radius of curvature of the inner race. This may be expressed in the formula: $C_s = KND^2F$, where C_s is static capacity in pounds, N is the number of balls, D is the ball diameter in inches, F is the curvature factor, K is a constant, (200).

The constant, K, is derived from laboratory tests involving the loading of balls on hard, flat steel plates up to the point at which any greater load would cause brinelling. The value of K is 200 for plates and balls having a hardness of 60, on the Rockwell C scale. The value of the curvature factor, F, is given in the table below. The proper value may be found by determining R, the ratio of the inner race diameter to the ball diameter.

R	4	6	8	10	12	14	16
F	.820	.875	.907	.930	.945	.957	.965

For values of F not shown, interpolation may be employed.

For capacity in rotation only, C_r, the values of C_s may be modified by using $K = 100$ and applying speed factors. Thus $C_r = 100\ ND^2F$ at 100 rpm.

For both rotation and reciprocation, the capacity is little affected by the rate of reciprocation as long as it is not excessive. There are other details which influence the capacity of this type of bearing. Some of them are deflection of parts, accuracy of workmanship, over-travel of load, and lubrication.

Some of the uses of this type of bearing are as follows: for engine governors, welding machine guides, propeller testing equipment, buffing machines, airplane landing gears, for gear grinders and lappers, and for remote control gear shift mechanisms.

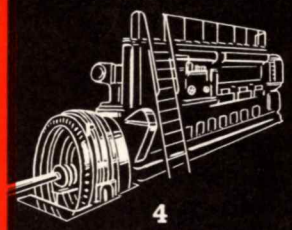
As the use of this type of bearing has occasionally been limited by its relatively low capacity, its field of usefulness should be greatly increased by use of the design here described which permits in general a doubling of the load carrying ability of ball reciprocating bearings.

WIN A WAR BOND . . . tell why

dag COLLOIDAL GRAPHITE

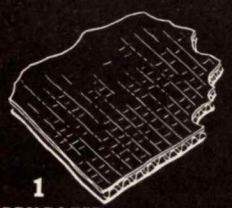
REG. U.S. PAT. OFF.

IS IMPORTANT in the Manufacture or Use of Each of the 4 Items Illustrated

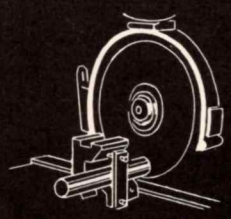


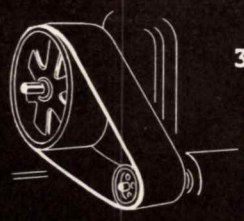
4 DIESEL ENGINE

3 LEATHER DRIVE BELT



1 CORRUGATED PAPER





2 ABRASIVE CUTOFF WHEEL

*dag Colloidal Graphite in the Electronics Industry

A graphite film formed from **dag** colloidal graphite is used on the inside walls of cathode ray tubes as a ray-focusing anode. Such a coating also serves to reduce light reflection from the glowing filament and because of getter properties it possesses, assures the maintenance of a high vacuum.

It is also possible to fabricate special non-metallic electrodes using mica discs carrying a graphite coating. In addition to being light and strong, they are non-magnetic and do not warp.

When the grids of certain types of receiving and transmitting tubes are treated with colloidal graphite, undesirable thermionic emissions are minimized.

Being resistant to electron bombardment, graphite coated tube parts do not readily emit secondary electrons. "Back" emission difficulties are likewise reduced since graphite films have little affinity for any particles that may be sputtered from activated filaments.

Coatings formed with certain **dag** dispersions are amply conductive to enable them to function as effective electrostatic shields. These are useful in connection with vacuum tubes, electronic musical instruments, special research equipment and the like.

Colloidal graphite may also be used for the production of both fixed and variable resistors. By altering concentration of suspension, method of application and subsequent treatments, it is possible to obtain a wide range of ohmic values.

These and numerous other applications for **dag** colloidal graphite in the field of electronics, are set forth in a new bulletin **432-A** available free on request.

*A TYPICAL APPLICATION

How to Win

Acheson Colloids Corporation will give a $25.00 War Bond to each of the 5 people who submit complete and accurate answers together with the 5 best letters on the question, "Why is **dag** colloidal graphite important in the manufacture and/or use of each of the products pictured here?" (1) State business connections (no one in the graphite field or their families is eligible). (2) All entries must be legible. (3) All entries must state the publication in which the advertisement was seen. (4) Entries must be postmarked not later than October 15, 1943. (5) In case of ties, duplicate awards will be made. (6) Entries become the property of the Acheson Colloids Corp. (7) The verdict of the judges will be final.

These are two more of the War Bond Winners. Others will be introduced in subsequent issues.

Mr. Fred. E. Schubert, Chief Engineer, Operation and Maintenance of the 20000 KW Municipal Power Station, Columbus, Ohio.

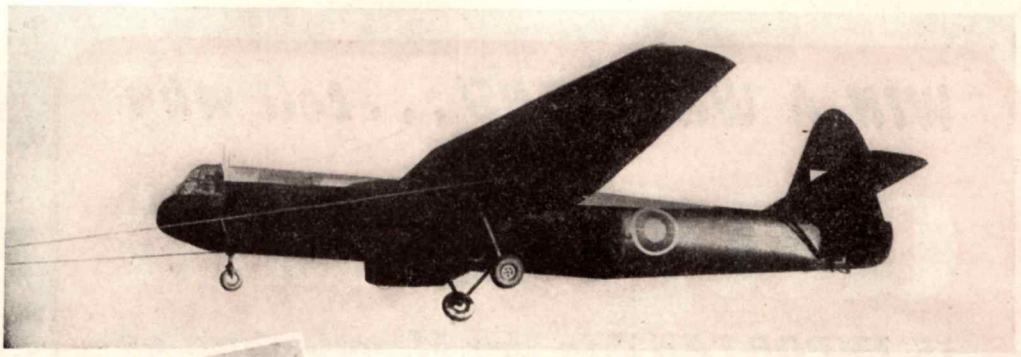
Mr. Edward Littlejohn with The General Engineering Company (Canada) Limited, Toronto, Canada.

dag REG. U.S. PAT. OFF. COLLOIDAL PRODUCTS

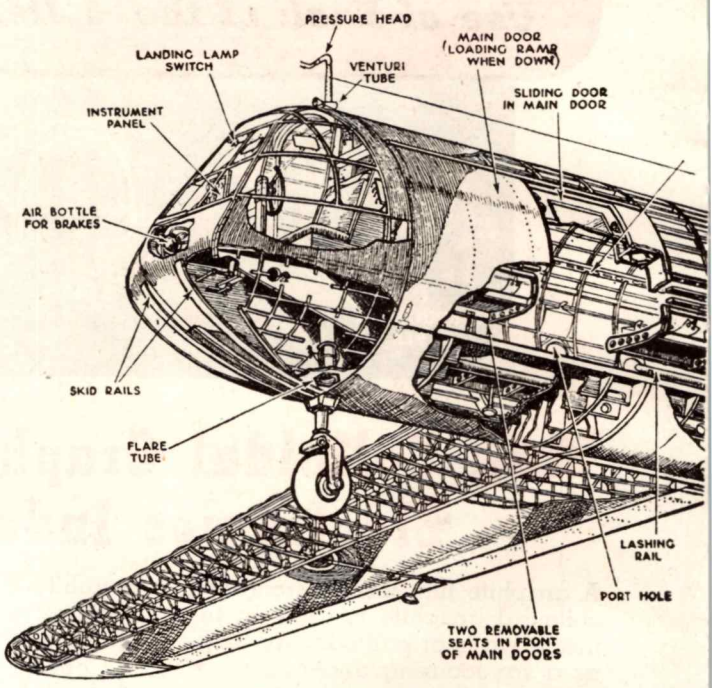
ACHESON COLLOIDS CORPORATION

PORT HURON MICHIGAN

The Airspeed "Horsa", British troop transport glider under tow. Aircraft wears black paint for nocturnal operations



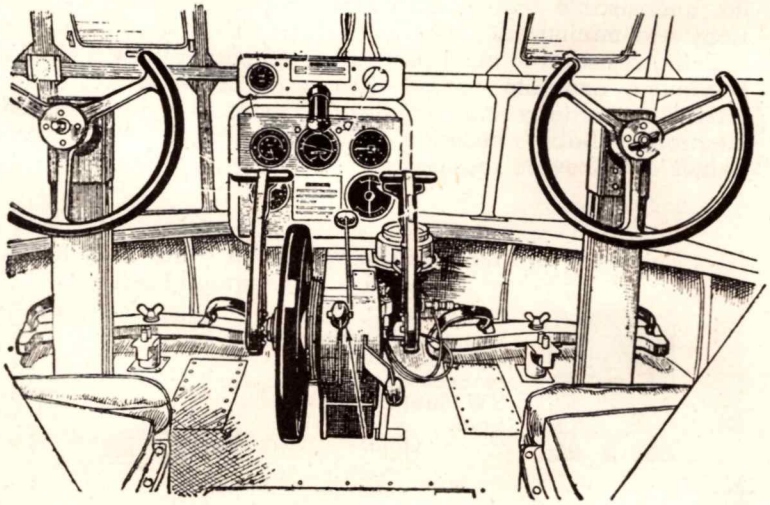
Below: Nose section. The windows, having four lights on each side and at top and eight in front, afford the two pilots wide visibility



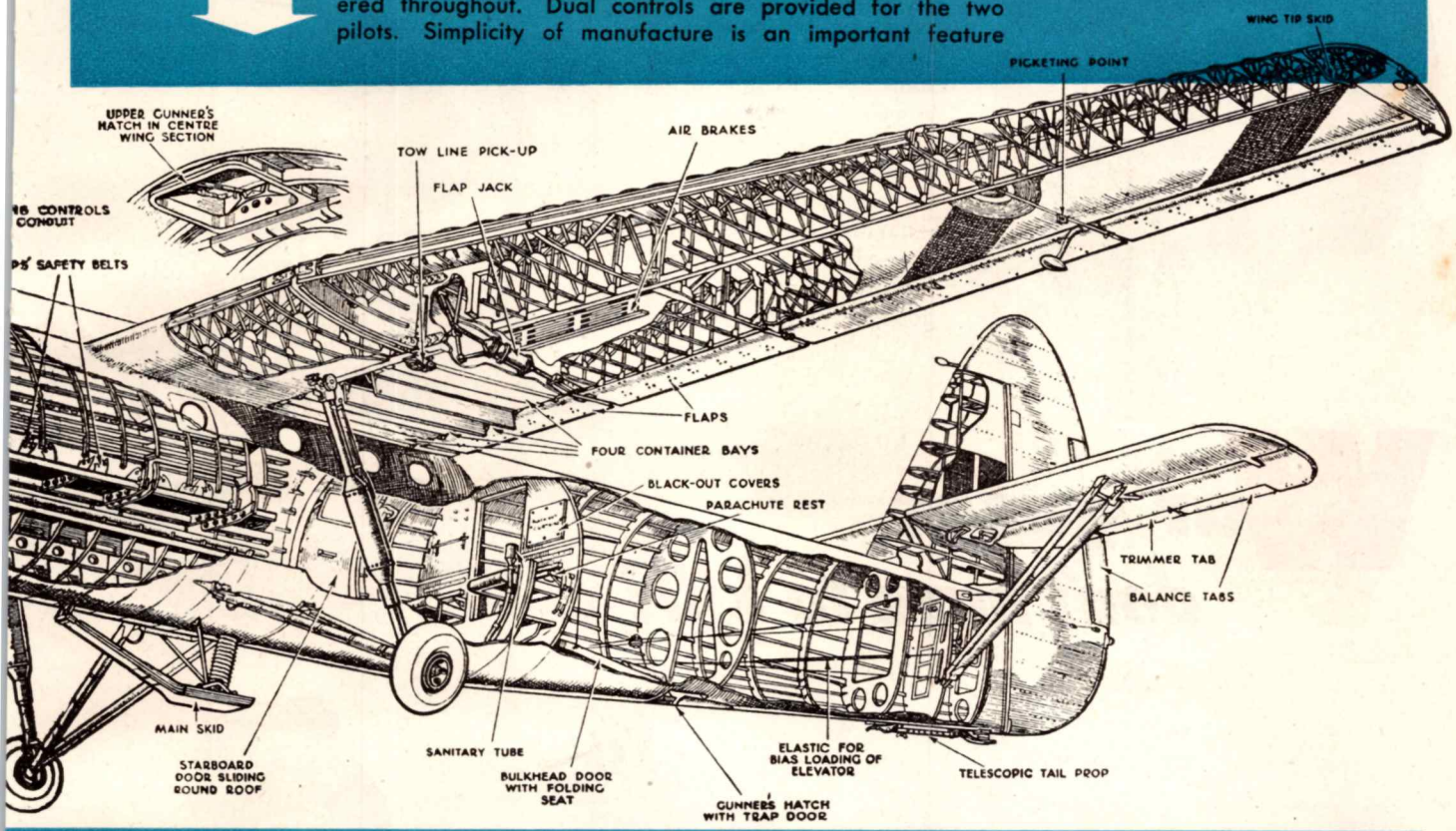
PORTFOLIO OF DESIGN FEATURES

THE "HORSA"

Interior view of cockpit. The rudder bars are easily detached by undoing wing nuts. Instruments include an altimeter, airspeed indicator, air pressure gage, artificial horizon, rate-of-climb indicator, turn and bank indicator and compass. Levers are for undercarriage jettison and for flap-control. Elevator trimming wheel at left center foreground

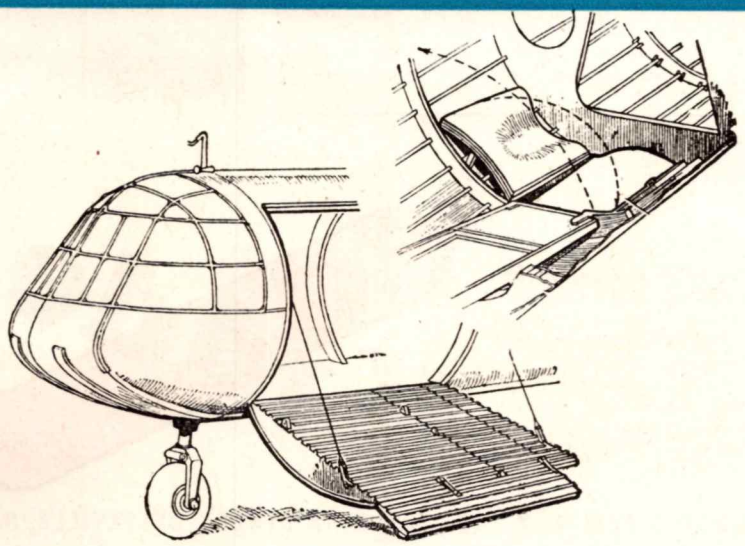


Internal layout of the "Horsa", showing principal features of its construction. This high-wing glider, which is built largely of wood, has a length of 67 ft; wing span, 88 ft; wing area 1104 sq ft; aspect ratio, 7; weight empty, 7500 lb; weight loaded, 15,250 lb. The long nose has necessitated a compensatingly large fin area aft. The fuselage is plywood-covered throughout. Dual controls are provided for the two pilots. Simplicity of manufacture is an important feature



GLIDER

Designed by Airspeed, Ltd., Britain's "Horsa" transport glider is being built by a number of different manufacturers. Used extensively for training, it has also figured prominently in most of the recent operations in which the RAF has employed gliders. The "Horsa" accommodates 25 passengers and a crew of three



View at left shows details of hinged door, which folds down when open to form a sloping gangway for convenience of troops boarding the glider. The door is located well forward on the port side of the rectangular center section of the fuselage. Shown at right is platform for prone gunner, and gunner's hatch (open)

Sketches, courtesy "Flight"

Have you heard about the new kind of war gases . . . friendly gases?

The man in the mask owes his life's breath to a war gas—oxygen. It keeps him alive as his plane streaks across the world's ceiling. Walter Kidde & Company has found use for many other war gases—carbon dioxide, compressed air, nitrogen and butane—gases that do good, not evil, in war-time.

A tank will burn for 24 hours—But not *our* tanks. Their big motors call for a lightning-fast fire-killer. A Kidde extinguishing system, custom-made for tanks, detects fire, flashes a warning, chokes it off with carbon dioxide—all in a matter of seconds.

War gases *don't have to kill!*

Kills fire fast—Kidde uses carbon dioxide snow-and-gas, one of the fastest known extinguishing agents, to kill fires in airplanes flying at top speed, to control cargo fires on shipboard and to protect war plants.

Floating on soda-pop gas—This same carbon dioxide gives buoyancy to the famous life-saving rubber boats. "Mae West" vests are also inflated by the carbon dioxide which Kidde uses in Soda King Syphons.

Walter Kidde & Company has devoted itself to the science of harnessing gases-under-pressure. War has greatly advanced the scope of this work. New uses are constantly being discovered, which will promote the comfort and safety of the postwar world.

WALTER KIDDE & COMPANY, INC., 911 MAIN STREET, BELLEVILLE, N. J.

MANUALS

(*Continued from page* 241)

The *Erection and Maintenance Instructions* manual includes descriptions of all mechanical, hydraulic and electrical units and systems: their maintenance, removal, tests before installation, installation, operational checks and maintenance inspection. The inspection instructions are listed under the following headings: Preflight; During Warm-up; Daily and Periodic. It is not unusual for this book to comprise as many as 900 pages.

The *Pilot's Handbook* includes complete operating instructions for both the pilot and the flight crew. It contains a brief description of the airplane and the location of all operation equipment, pilot's operating instructions, information on flight operations (including weight and balance), operating instructions for the different radio sets, operation of the armament equipment and a chapter on emergency equipment.

Many Photographs

This book usually has from 60 to 75 pages with about 50 to 60 photographs, illustrations in several colors, operating tables, and charts. To emphasize the most important operating instructions, humorous cartoons are inserted in the text (see fig. 5).

The *Structural Repair Handbook* includes all the information necessary for substantial repairs of airplanes in the field or in a repair depot. This manual is compiled by experienced structural engineers who analyze design and stress and check typical repairs, both general and specific.

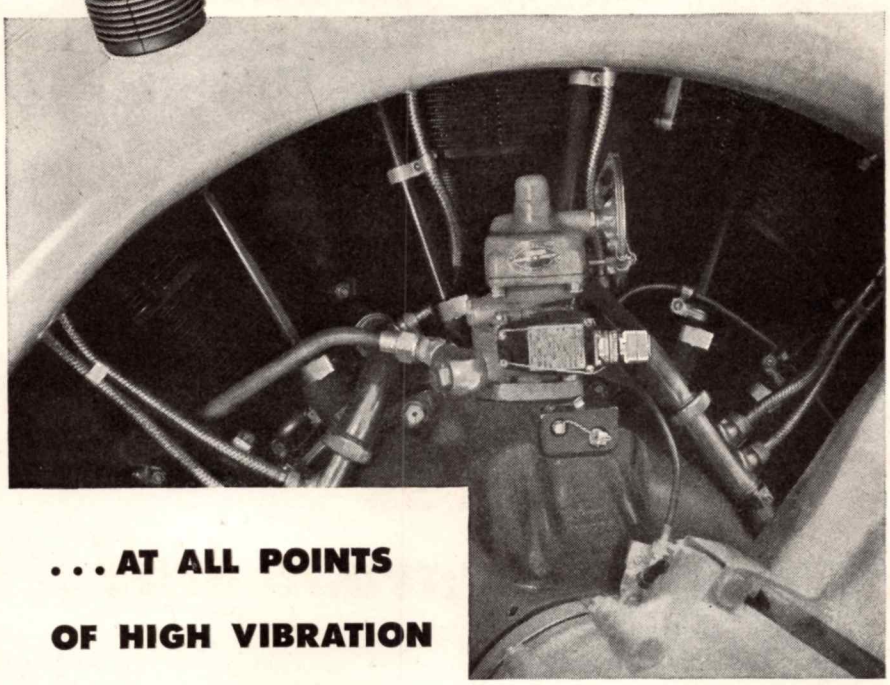
There is a chapter on general instructions which includes discussion of methods for supporting structures during repair, of riveting practice, of aluminum alloys, corrosion prevention, finishes and camouflage. Other chapters are devoted to specific repairs of wings, of fin and rudder, of stabilizer and elevator of the fuselage, landing gear structure, engine nacelle and support structures of the cowling, fuel and oil tanks, and miscellaneous structures.

More attention is constantly being given to emergency repairs. The repair manuals group at Vega has made a special study of what are termed "haywire repairs," based upon conditions which actually exist in combat zones. In this respect, much valuable information has been obtained from Army and Navy men upon their return from the theaters of war.

The average *Erection and Maintenance* manual contains between 600

(*Continued on page* 279)

STEADY PERFORMANCE



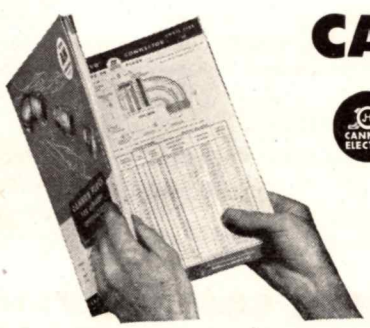
. . . AT ALL POINTS OF HIGH VIBRATION

This special vibration-proof Cannon Connector, because of its precision-built unit construction, is highly desirable for use on equipment which is subject to excessive vibration . . . such as the feathering governor, mounted behind the propeller.

The special type of Cannon Connector developed for use in this exposed position retains the coupling ring on the fitting by means of a phosphor bronze retaining ring designed in such a manner that permanency is assured. The barrel and the major portion of the shell are cast in one piece in order to withstand vibration.

This connector is just one of the many thousands of types made by Cannon for connecting and disconnecting electrical circuits quickly and with absolute certainty.

The Bulletin on Cannon Type AN Connectors . . . gives a complete explanation of construction and operation of AN plugs. 82 pages with ample illustrations. Address Dept. A-103, Cannon Electric Development Co., Los Angeles 31, Calif.

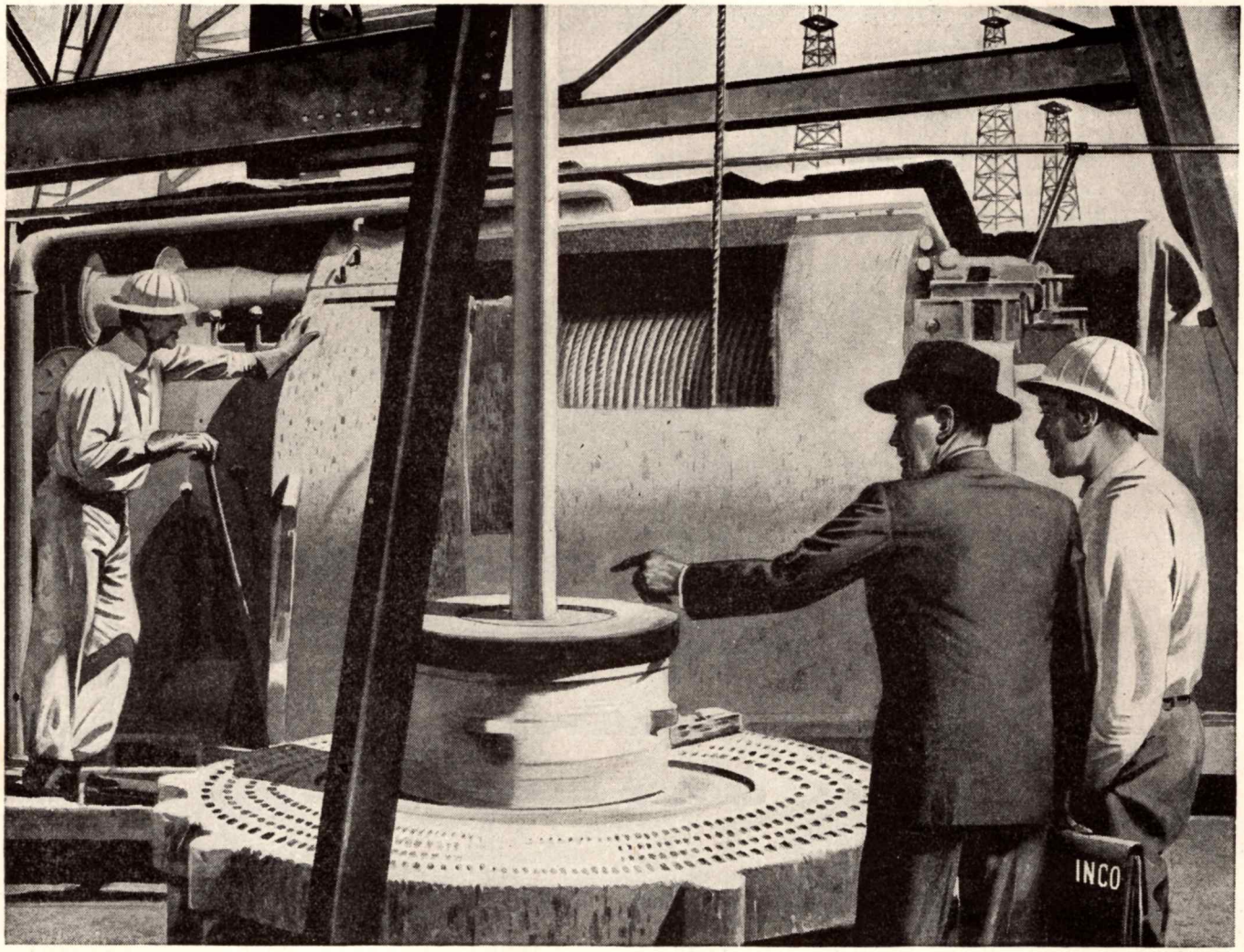


CANNON ELECTRIC

CANNON ELECTRIC

Cannon Electric Development Compan
Los Angeles 31, California

Canadian Factory and Engineering Office:
Cannon Electric Company, Limited • Toronto, Canada



NICKEL AIDS THE PETROLEUM INDUSTRY

to KEEP 'EM PRODUCING!

Oil is ammunition. On every battle front, oil is war material number one.

Besides power for ships and subs, planes and tanks, trucks and jeeps, it also provides the basic ingredients for synthetic rubber, toluene for TNT, chemicals, and many other essential war materials.

To meet increased wartime demands for oil, field and pipeline equipment carries heavier loads. Refineries make longer runs at high heats and pressures. Engineers add sub-zero cycles and new catalysts. Equipment is taxed up to and sometimes beyond rated capacity . . . precision equipment that cannot be readily replaced.

Despite emergency schedules, however, that equipment rarely fails. For, since the days when shallow wells were drilled with wooden rigs and kerosene was shipped in oak barrels, oil men have relied largely on stressed parts strengthened and toughened by additions of Nickel.

The oil industry knows many uses for Nickel alloyed materials, from crown blocks to drill bits, from sucker rods to pressure stills. Alone, or in combination with other alloying elements, Nickel helps metals resist corrosion, retard wear and absorb shock overloads. Properly used, a little Nickel goes a long way to insure dependable, uninterrupted operation of production and refining units.

For years the technical staff of International Nickel has been privileged to cooperate with petroleum engineers whose pooled information and "know-how" are now so vital to Victory. To men in all industries who desire assistance in the selection, fabrication and heat treatment of ferrous and non-ferrous metals, INCO engineers and metallurgists offer counsel and data.

New Catalog Index

New Catalog C makes it easy for you to get Nickel literature. It gives you capsule synopses of booklets and bulletins on a wide variety of subjects — from industrial applications to metallurgical data and working instructions. Why not send for your copy of Catalog C today?

* *Nickel* *

THE INTERNATIONAL NICKEL COMPANY, INC., *67 Wall St., New York 5, N. Y.*

(*Continued from page* 277)

and 700 illustrations; the *Pilot's Handbook,* between 50 and 60; the *Structural Repair* manual, between 200 and 250. As the three manuals usually are worked on simultaneously, it is important to keep close control of the illustration work. And since illustrations take up about half the time spent in the preparation of manuals, accurate timing is required to balance the load so that all reproduction copies for illustrations will be ready simultaneously with the corresponding text.

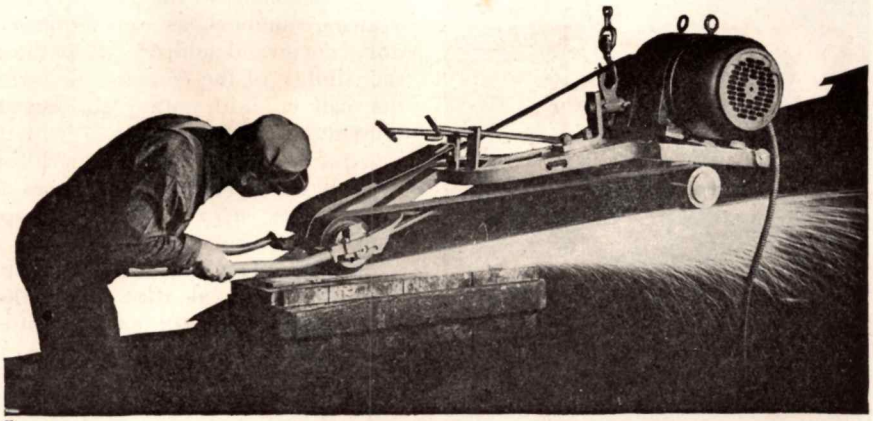
Wherever a part is first introduced into the text, the compiler adds a single column close-up photograph to show the item. Each additional illustration must be inserted at exactly the point where it is needed to illustrate the text. At this stage of the work the final sequence figure number is not yet known, so an index number is used in place of it. The entire coordination between the illustrations and the text depends upon the proper use of this index number.

Index Number

The index number is a composite one, which designates the section, chapter, and figure number, and is used for identification purposes. For instance, the third illustration in chapter 10 of section 6 would be labeled S6-10-F3. As the compiler adds illustrations index numbers are assigned consecutively. When the rough draft manuscript comes up for editing, the compiler submits a new illustration list with the figure titles in their correct sequence as they will appear in the finished book. On this list he marks the original index number after each title. At the conclusion of all writing these lists are arranged in section sequence and all figure titles assigned consecutive figure numbers straight through the book. This coordinating record provides the relation between the index number and the title and figure numbers.

In handling the illustrations in the group, only three forms are used, (see fig. 6). The compilers fill out an illustration request in triplicate; one is for the compiler's record, another is for the illustration supervisor's file, and the third goes to the illustrator who makes the drawing, does the rendering or retouching. his fTorm lists all the pertinetn information, such as title, reference engineering drawings, reference photos, type of illustration required (line drawing, perspective, retouched photo, air brush, or rendering), as well as special instructions to the illustrator. It also indicates if "callouts" are required.

Callouts are referenced to legend printed below the picture, which gives



and Better
Something NEW Has Been Added!

METALITE CLOTH BELTS
Improve Swing Frame Grinding

Special, heavy-duty METALITE Cloth Belts on new type swing frame grinders make amazing production records.

On many heavy metal grinding and snagging operations these fast, cool cutting abrasive belts with smooth running "Uniflow" joint, do a better job in less time at lower cost than solid or set up wheels on swing frame grinders.

Remove More Stock
Heavy-duty Metalite Cloth Belts are out-producing snagging wheels at rates of 4 and 5 to 1 in amount of stock removed.

Cut Faster
Stock removal is done more rapidly with grinding time reduced as much as 60%.

Cut Cooler
The larger cutting area of Metalite Cloth Belts generates less heat and assures faster dispersion.

Approximate ratio: 544 square inches in the belt, 100 square inches in a 16″ x 2″ wheel.

Finish Better
These fast, cool cutting abrasive belts give far better finish than could possibly be secured from the rigid face of a coarse, solid snagging wheel.

Increase Production
More metal removed in shorter time gives desirable cumulative increase in hourly production.

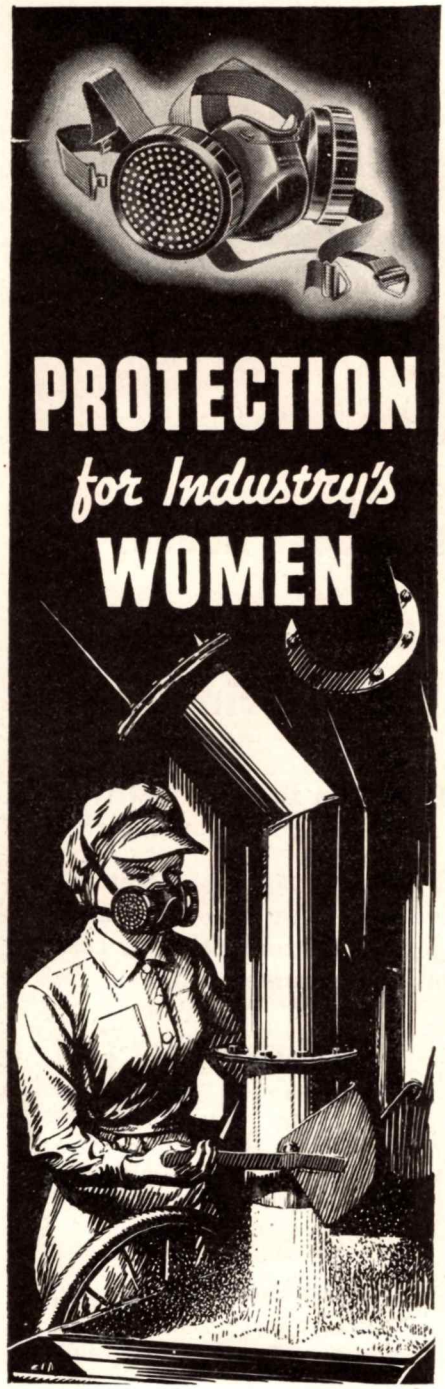
Reduce Costs
All these advantages of Metalite Cloth Belts in swing frame grinding operations combine to lower costs and give a better product.

BEHR-MANNING
(DIVISION OF NORTON COMPANY)
TROY, N.Y.

Be Sure to INVESTIGATE
MAIL THIS COUPON

Please send folder on *NEW* Swing Frame Grinding Methods

Firm Name .....
Street Address .....
City ..... State.....
by ..... Title.....



As women willingly assume more hazardous jobs, they deserve—and are getting—every consideration for their health and safety.

Willson, leader among the makers of eye protective and respiratory devices, has engineered many special devices or adaptations for the ladies. Willson Respirator 570, for example, is particularly suited to women . . . protecting against metal fumes encountered in welding . . . toxic dusts . . . and acid mists. Your local Willson representative will gladly furnish additional information.

GOGGLES • RESPIRATORS • GAS MASKS • HELMETS

DOUBLE WILLSON

PRODUCTS INCORPORATED
READING, PA., U.S.A. *Established 1870*

the proper name of the parts, reference drawing numbers, as well as the vendor's name and address. It is the responsibility of the compiler to furnish the callout information so that the illustrator can coordinate it with the illustrations, (see fig. 7). To save time, the callout circles and numbers are printed on a good grade paper, punched out and gummed to the art work with a special glue which permits their removal after use, without damage to the illustration. Thus it can be used again.

The illustrations used are perspective drawings made from photos, engineering drawings of actual parts, or retouched photographs. The drawings are either black and white, with or without color overlays, or rendered by airbrushing or wash colors, (see fig. 8).

To insure good photographic reproductions, all rendering is done with opaque colors in six shades of gray. This is necessary in order to "snap out" the background in clear white. After much experimentation, good photographic results have been obtained.

Use of Cartoons

Humorous cartoons are employed in connection with the subject matter of these manuals. The purpose is to lighten up the reading matter, emphasize an important message—such as a warning note to the pilot—and to fill out blank spaces in the book and prevent the page indexing from getting out of step, (see fig. 9).

Some of the illustrations are strictly technical drawings, such as electrical wiring diagrams and layouts of structural repairs, all drawn by engineers. The rendering of illustrations is done by experienced artists, while perspectives are made by younger artists and production illustrators just out of art school. Many of the latter are women.

To insure consistency and technical accuracy, preliminary sketches are prepared by a layout man who is technically versed and thoroughly familiar with airplane practice. The layout man works closely with the compilers.

Complicated plumbing diagrams are difficult to interpret unless they are presented in colors that differentiate the various lines. These color reproductions are made by means of overlays. This is usually done by tracing and inking the different color bands on separate, transparent acetate sheets. Considerable work is required in which the chief problem is that of obtaining proper registration between overlays—a problem caused by the shrinkage of film and paper when the original is photographed.

The "jelly," or gelatin process, has recently been introduced, with the purpose of cutting costs and reducing the time required to make overlays, as well as of obtaining more perfect registrations. Through this process, perfectly registered duplicates of line drawings are made on art board. These duplicates appear in very faint blue lines which do not show on the photographs. The blue line areas, which are to be printed in color, are inked in on the registered duplicate and photographed individually. One duplicate art board is made for each color to be printed.

Vega has pioneered in two types of illustrations for service manuals: one is the electrical wiring diagram upon which a perspective sketch is superimposed, showing the location of the junction boxes and control panels included in the wiring diagram; another is the "pull-out" drawing, of which an example is shown in fig. 10. This type of illustration presents a cross section of the part, showing both the operation of the unit and a pulled out assembly which indicates the sequence of removal or assembly of all component parts in the assembly. With such an illustration even an inexperienced mechanic can either disassemble or put together a unit with which he is unfamiliar.

Occasional field trips are made by the service group supervisors to Army and Navy operating activities. The object is to cooperate on common service difficulties, as well as to find out whether the information contained in the books is adequate. These trips also provide an opportunity for the gathering of specific information for these manuals, whose revision and improvement represent a real contribution to the nation's gigantic wartime training program.

PROPELLER TURNTABLE

(*Continued from page* 215)

lows just over 4 hrs for each curing cycle, or half-turn of the table. A complete revolution therefore requires a little over 8 hrs.

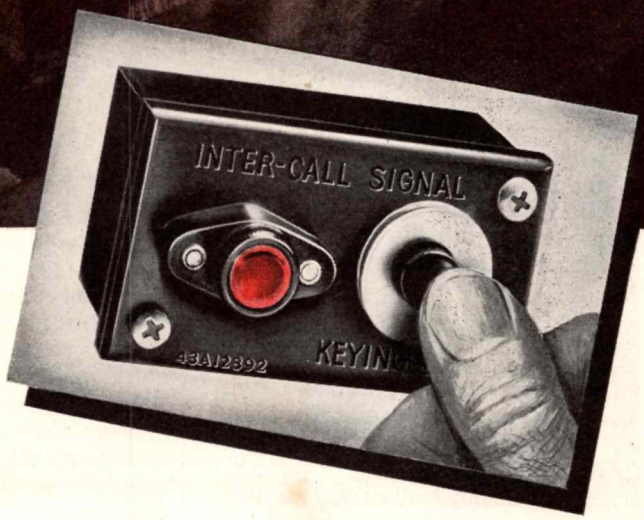
The first step in the operation takes place at the loading station where the inside of the mold is coated with wax, after which the steam in the mold is turned on. A blade about which a fairing has been built by hand from molded pieces of sponge rubber covered with sheets of uncured ebonite is then inserted into the mold which is loosely bolted. The turning of the table carries the mold under one of the two 100-ton Farquahar hydraulic presses, which closes it under pressure. This forces out excess rubber and allows the mold bolts to be tightened.

After the mold, with its blade, advances to the next position, a canvas and wool insulation blanket is put over

(*Continued on page* 282)

At his FINGER TIPS...
an EYE for the EARS of his crewmen

In multiplace aircraft where interchangeability of the crew is impossible, intercommunication links each separate member into a single, inseparable unit. Thus each man's duty is coordinated with that of every other member. It's the TEAM-WORK that counts. Standair's Inter-call Signal Unit is a vital part of the communication system in modern observation and bomber aircraft. The red ***EYE*** says ***GET ON*** the inter-call system, enabling the operator to give instructions and reports to any one or all crew members. Standard Aircraft Products, Incorporated, are contractors to the U.S.A.A.F., the R.A.F., the R.C.A.F., and individual airplane manufacturers for this and various aircraft lighting equipment, aircraft power plant controls, other aircraft products and accessories.



INTER-CALL SIGNAL BOX
MADE BY STANDAIR

A.A.F. Drawing No. 43A12392
Standard Aircraft No. SA-2920-B

Weight 5 oz. Overall length 3", width 1⅝", depth 2¾". Write or wire for engineering data sheets with detailed specifications.

"STANDARD Products—
Standard for the Industry"

STANDAIR

STANDARD AIRCRAFT PRODUCTS, INC.
DAYTON, OHIO

SALES OFFICES: *Sterling Aircraft Products, Inc., 1831 Graybar Bldg., New York City*
Hartwell Aviation Supply Co., 3417 Crenshaw Blvd., Los Angeles, Calif.
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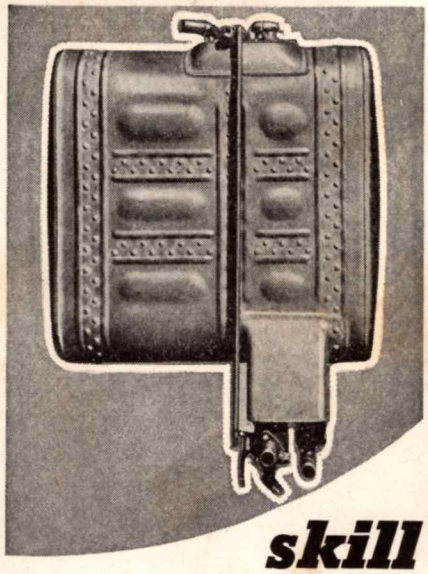


skill born of experience

Mercury craftsmanship was built up through more than a score of years devoted exclusively to the production of aircraft and aircraft parts; hence wartime demands found us with the equipment, experience and specially trained artisans to deliver vitally needed parts quickly . . . without the delay of plant conversion and the hazard of hastily trained workers.

aluminum tanks

For instance, plant 2 is a completely equipped unit for fabricating and finishing of tanks of any type . . . forming, riveting, welding anodizing, testing and painting...progressing smoothly, steadily and swiftly from shining sheet to cartoned shipment.

Aircraft makers know they can depend on Mercury quality and deliveries alike, for tanks, surfaces, parts and accessories.

At the Cradle of Aviation

MERCURY AIRCRAFT INC.
HAMMONDSPORT · NEW YORK

(*Continued from page* 280)

it to conserve heat and protect the workers. The table now carries the mold by progressive steps about one-third of the way around its circle, completing the heating cycle under steam pressure. At this point the heat is turned off and refrigerated water is circulated through the mold. Blade and mold are then cooled for a little over an hour until the combination reaches the unloading station 180° from the loading point.

These huge presses are among the largest open-sided units ever made. The mountings of the rotary table near the presses are on steel springs, so that there will be a slight "give" to bring the table into contact with the lower platen of the press while the mold is being closed. When the pressure is released the table lifts and clears the lower platen by approximately 1/16 in.

Six electric hoists travel on an overhead track to open and close the molds. Two are of 2000-lb capacity and four of 1000-lb. These are supplemented by two 500-lb crane hoists.

The machine was planned by Hamilton engineers to provide continuous, uniform molding of the rubber fairing with a minimum of handling. The design and construction were carried out by L. Heres DeWyk Co., Ansonia, Conn.

ELECTRONIC CONTROLS

(*Continued from page* 213)

mercury has been distilled off. This takes longer than does the usual cathode heating. To keep the mercury off the elements, mercury-vapor tubes must be kept upright as much as possible.

Some electronic panels are designed to use tubes on external loads. These loads should not be greater than either the average or the peak rating of the tubes. Sometimes an operator will increase the anode voltage, replace coils, or alter motor pulleys or gearing to obtain a greater output, thus overloading the tubes. If tube life is not to be seriously reduced, such practices should be avoided.

The best trouble-shooting tool is a clear knowledge of the operation of the panel and of each of its parts. If only partial operation is obtained the trouble may be isolated to a part of the circuit. Since many circuits on electronic panels have a very high impedance, meters having high impedances are very desirable in servicing the equipment. A useful tool is the radio service multimeter which has a resistance of 1000 ohms per volt or higher. For some circuits, however, an electronic meter, such as a vacuum-tube voltmeter of the d-c reading type or a cathode-ray oscilloscope, is essential.

The cathode-ray oscilloscope, particularly when modified to read d-c potentials, is an extremely useful device because it combines a very high impedance voltmeter with a time axis, thus making visible voltage changes much too rapid for the ordinary meter to follow. Instantaneous thyratron grid and plate potentials and other voltage waveforms may easily be observed on the oscilloscope and any incorrect operation quickly detected.

In trouble-shooting on electronic control, one should first make sure that the trouble lies in the electronic equipment: Is power available at the control panel terminals? Can the motor or other device be operated by alternate means—such as from a d-c bus by drum switch or magnetic control? Are all protective devices and interlocks outside of the panel operating properly? Has the cathode protective timer relay completed its timing cycle and applied anode power? Have mechanical adjustments been disturbed where items such as scanning heads or other mechanical components are used?

The occasions on which failures occur may roughly be divided into three categories: when the equipment is new; when starting after a normal shutdown; and during operation.

New electronic equipment may fail to start because of a lack of correct power, because of incorrect or missing connections, tubes in wrong sockets, use of wrong or defective tubes, no fuses, a wrong size fuse, or because of damage done to panel leads or parts in shipment.

Check Incoming Power

Incoming power should be checked against the panel nameplate rating. The remedy for no power and for missing wires and fuses is obvious. The position and type of tubes can be checked by referring to the wiring diagram and the panel stamping. Defective tubes and (sometimes) those in wrong sockets may not heat up. Usually the glow of the hot cathode can be seen in glass tubes; in metal tubes the envelope becomes hot to the touch. The envelope of metal thyratrons and ignitrons is at cathode potential. These must not be touched while power is on the panel.

When the electronic equipment does not operate after a normal shutdown, power, interlocks and safety switches should first be checked. The cathode heating timer relay may have failed or the anode contactor may be defective. An old tube often fails because of expansion and contraction as the power is switched off or on. Fila-

ment or heater burnouts may be quickly detected by inspecting glass tubes or by feeling metal tubes for heating. Sometimes an overloaded transformer or reactor will fail, due to the expansion cycle, as power is removed and applied. Here, however, warning of failure is usually given by excessive heating, by the odor of the hot material, by the melting of the sealing compound, or by the smoking or charring of the insulating paper.

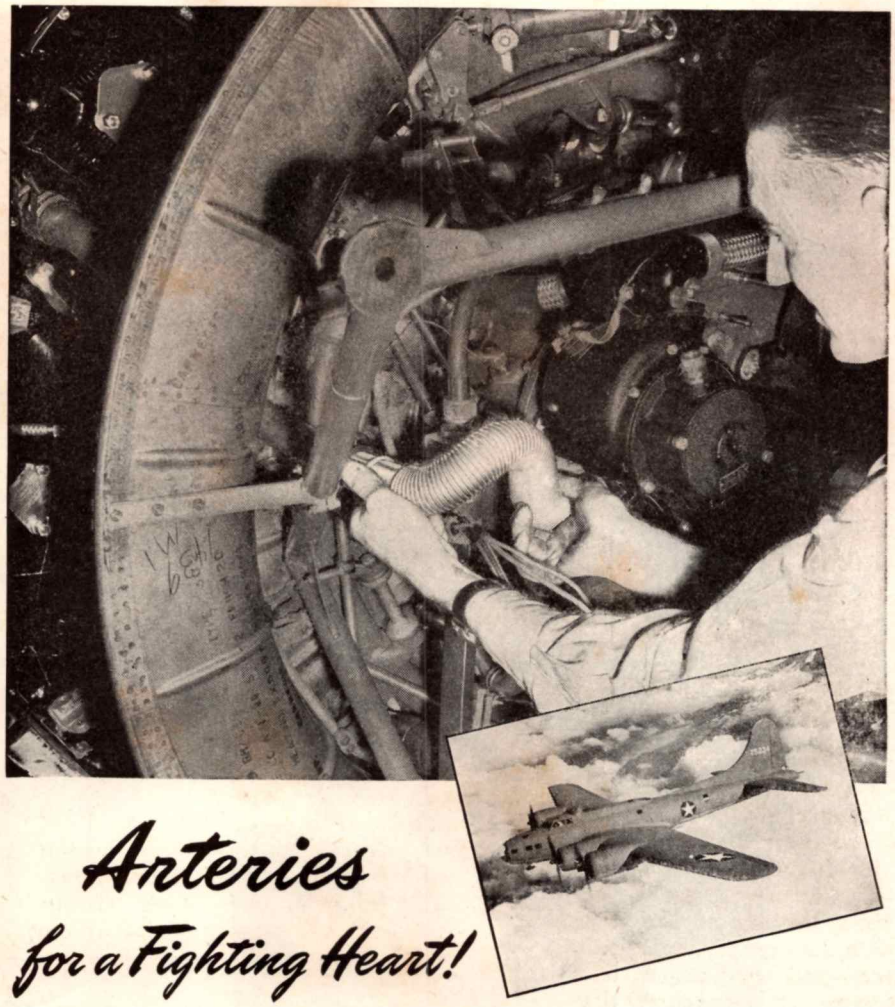
When failure occurs during operation, the equipment's performance either becomes noticeably unsatisfactory or ceases altogether. In such cases, by noting the exact symptoms of the failure, it is often possible to identify the trouble with a specific cause. Power failure or a blown fuse produces an instantaneous change in the equipment's operation. An overload on a transformer, resistor, or wire is usually indicated by heat and smoke before total failure occurs. The cause of overload—whether short-circuit, load-coil burnout or motor-bearing failure—must be ascertained and corrected before the equipment is again placed in service.

When a tube cathode circuit fails, the cathode cools gradually over a period of seconds, even minutes. The loss of operation therefore, may be gradual, rather than sudden as in the case of power failure. However, small rectifier and batter-operated tubes cool quickly.

Trouble-Shooting

Should none of the above causes for failure be evident, it will be necessary to go carefully through the operation of the circuit and to analyze each step. An instruction book for the particular panel, or at least an elementary diagram of the circuit, should be available. If the circuit is at all extensive, it usually is possible to divide it into two parts: the control circuit and the power circuit. Then, as the input is varied over the normal range, a meter. electronic voltmeter, cathode ray oscilloscope, or some other means may be employed to determine whether or not the control section is operating correctly. Likewise, to test the other half, a simulated control signal may be applied to the power circuit.

In a similar manner, each part of the circuit can be subdivided until the faulty circuit or part is found. With a clear knowledge of each part of the circuit, this procedure can be carried out quite rapidly. It is a good idea to check the operation of panels while they are functioning correctly, recording the voltages found and cathode ray traces discovered between specific points. In this way the differences found in a defective panel will be immediately evident.



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REX-FLEX Stainless Steel Flexible Tubing is battle-tried and proven—at the heart of the giant motors which power the Boeing Flying Fortress—on equally important applications on many other of our latest, largest and most formidable military aircraft.

In aircraft production the adaptability of REX-FLEX for installation facilitates the flow of parts through manufacture to assembly and speeds the convergence of major units into final assembly.

REX-FLEX characteristics of light weight, strength, flexibility, and resistance to corrosion, heat and vibration are solving an ever increasing number of vital problems in aircraft design and construction. Like the accomplishments of the aircraft industry itself, the application developments of REX-FLEX, considered impossible mere months ago, are commonplace production line assemblies of Chicago Metal Hose Corporation.

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The SHEFFIELD MICRO-FORM GRINDER

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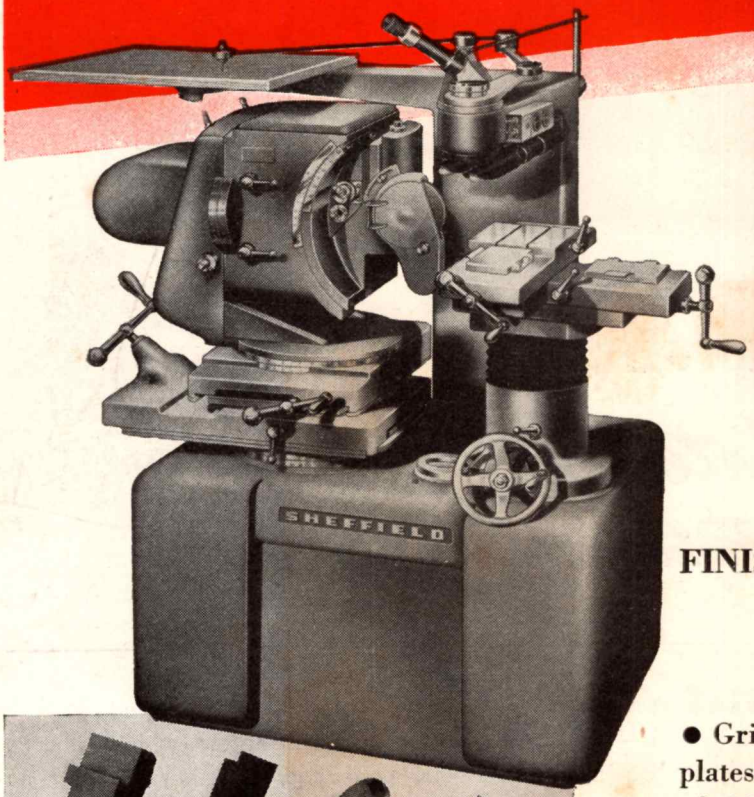
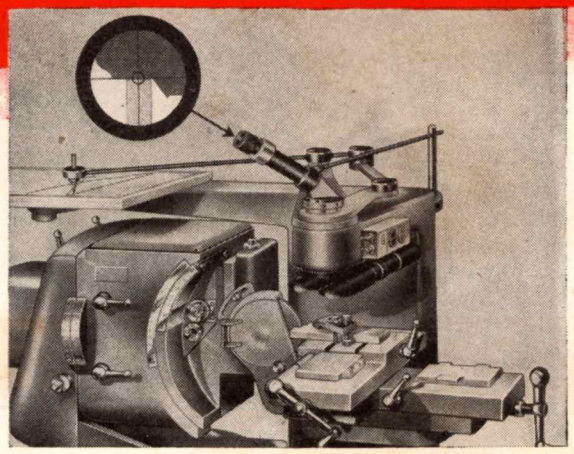
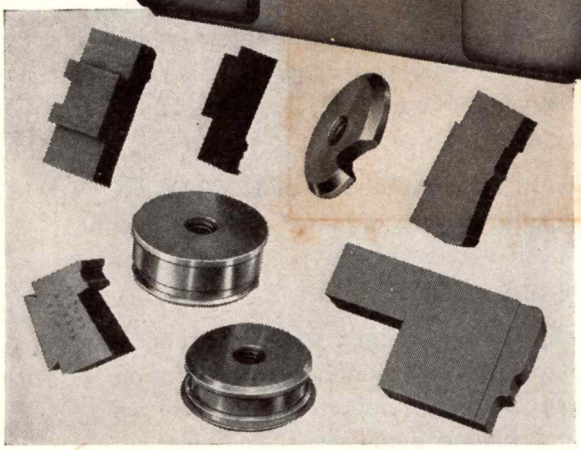




Operator feeds grinding wheel toward point marked by cross hairs.



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ARMY E NAVY

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THE SHEFFIELD CORPORATION

Dayton 1, Ohio, U.S.A.

MACHINE TOOLS—GAGES—MEASURING INSTRUMENTS—CONTRACT SERVICES

USE RETURN CARD FOR QUICK ACTION

AERO EQUIPMENT Digest

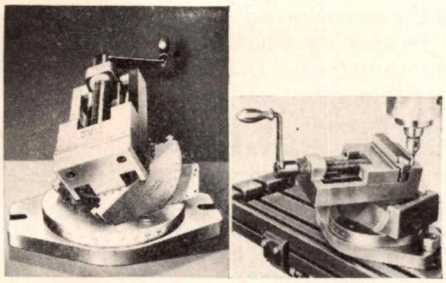
DR. ALEXANDER KLEMIN
Consulting Editor

UNIVERSAL VISE

AeroED 1859 (Sept. 1943) . . .

Universal machine tool vise for angle milling, drilling, grinding, boring, etc.

The Wesson universal vise may be mounted on any machine tool for any angle machining operations and permits setups for the most complicated compound angles readily and accurately. It can be employed in angle milling, drilling, grinding, boring, reaming, slotting, buffing, tapping, honing, spot facing, counter-boring, super finishing, grooving, lapping, planing, shaping, die-sinking, and other machine operations. The vise is quickly mounted by T-bolts, is completely portable and may be moved from one machine to another without disturbing the angle or removing the work, thus permitting a whole series of angle operations at the fixed angle required. Rigidity and the distinctive cradle construction assure freedom from chatter, and provide ability to handle heavy cuts. The vise swings through 180° in the top plane, 90° in the vertical plane, and 360° in the bottom plane, and is completely graduated in all planes.



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One photograph shows the machine itself, the other illustrates angle milling. It is claimed, and with reason, that the universal vise combines high accuracy with precision and a remarkable range of uses.

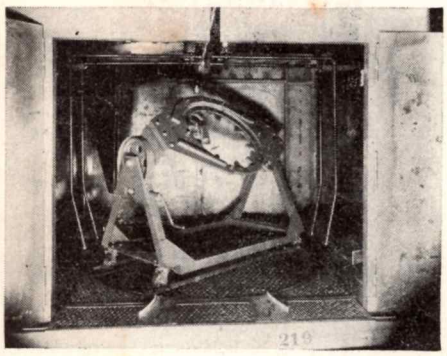
Wesson Co., Ferndale Sta., Detroit, Mich.

CLEANING OF AIRCRAFT ENGINES

AeroED 1860 (Sept. 1943) . . .

Machine which cleans the entire aircraft engine in one operation as it comes off the assembly line.

Uniform and continuous cleaning of the engine is obtained by the use of a turntable designed to hold the engine and its assembly stand as it comes off the production line. This turntable revolves at 4 to 6 rpm to produce complete wash, rinse, and drying operations on one engine in about 20 mins.



Wash and rinse solutions are both applied through one set of spray pipes which extend completely around the engine and its stand. First wash water, then rinse water, is pumped on the engine parts, after which heated, high-velocity air is ejected through the blow-off nozzle, to dry excess water from the engine surfaces.

The machine illustrated is 13 ft high, and

(*Continued on page* 287)

USE RETURN CARD FOR QUICK ACTION

3 Vital Information Services in One

For the convenience of busy executives, department heads and others whose time is valuable and who must keep themselves informed of what's new and helpful to aviation's war efforts.

1 Qualified aviation personnel may obtain additional information on the items presented in AERO EQUIPMENT DIGEST by means of the attached postage-paid reply card. Please indicate items in which you are interested by inserting key number given at beginning of each description. *Be sure to fill in month and year,* in space provided on card; also address, aviation connection, etc.

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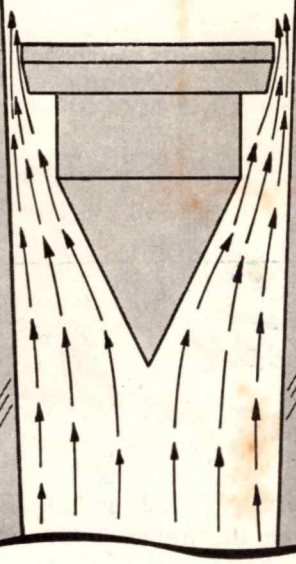
The ROTAMETER

—its basic advantages over head-type meters

8 BASIC ADVANTAGES

1. Metering elements and fluid being metered clearly visible
2. Wide flow range—20-to-1 easily obtained
3. Evenly spaced scale divisions—no compression of scale at low flows
4. Low, constant pressure drop—reduces pumping costs
5. New Stabl-Vis rotameter compensates for viscosity and density variations
6. 10″ to 24″ travel of metering float—accuracies correspondingly high
7. Instantaneous response to flow change—no friction or hysterisis
8. Measures corrosive gases, liquids and slurries that no other meter will handle accurately



1. Metering elements and fluid flow CLEARLY VISIBLE

Due to its transparent metering tube, the initial high accuracy of the rotameter may be readily checked and consistently maintained. At a glance the operator can actually see the condition of the rotameter float, the metering tube and the fluid flowing through the meter. The very minute that dirt starts to accumulate or that corrosion sets in, the flow may be by-passed and the rotameter quickly cleaned. No guesswork—no pressure lines to constantly blow down—no seal pots or sealing fluids required.

Furthermore, the accuracy of the remote-reading recording pen or indicating pointer may be quickly checked by comparison with the readings of the rotameter float. The operator at the rotameter sees the correct flow rate reading—so does the control man at the instrument panel.

Full visibility is but one of many basic advantages of the rotameter—a complete and informative explanation is given in our interesting booklet 10-A, entitled "A New Era in Flow Rate Measurement." A copy will be gladly sent without obligating you in any way if you will write to Fischer & Porter Co., 209 County Line Road, Hatboro, Pa.

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THE "ROTAMATIC"
Automatic Flow Rate Controller

If you will read the eight basic advantages of the rotameter given above, you will understand why the "Rotamatic" offers you a new and better method for flow rate control. For the first time, the rotameter is available in combination with automatic pneumatic control of improved design. All the limitations of flow control with fixed orifice meters are removed.

The "Rotamatic" gives "hair-line" control at any flow rate in the range of the rotameter connected to it—*plus* wide range, low pressure loss, straight line calibration, visible primary metering element and high accuracy. Available with electrical transmission, and also with magnetic transmission for services where there is an explosion hazard.

Every up-to-date Instrument Engineer ought to know about this new instrument for automatic flow control. For full details, write for bulletin 50A.

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F&P ROTAMETERS

RATE OF FLOW INDICATING, RECORDING OR CONTROLLING ROTAMETERS FOR ANY LIQUID OR GAS

(*Continued from page* 285)

is sunk 4 ft below floor to conserve space and to facilitate loading — the engine and its stand can be loaded directly into the machine without any lifting. This machine can be designed to accommodate any size engine and stand.

It is also well-suited to airfield use—on teardowns and assembly of engines, and to wash smaller, separate parts in baskets placed on the turntable.

•

The new machine has proved conclusively that it can reduce time and manpower in cleaning almost any type of aircraft engine.

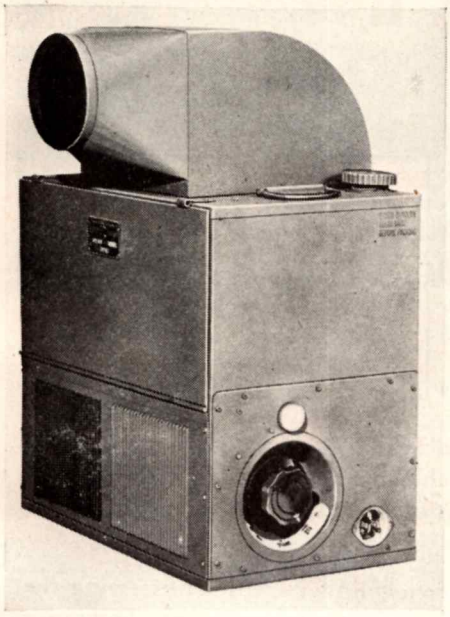
Howard Eng'g & Mfg. Co., 1010 Hulbert St., Cincinnati, Ohio

HEATING AND VENTILATING UNITS

AeroED 1861 (Sept. 1943) . . .

Compact heating and ventilating units burning any kind of gasoline or leaded fuel, and having a wide range of uses associated with aircraft.

Some uses of these units are: Heating and ventilating tents and barracks of personnel; heating and ventilating of mobile or tent repair shops, laboratory trailers, shelters for



delicate equipment and small portable buildings of all types; stand-by heating of engines and other equipment. The new heaters, which were developed originally for a special Army use, are now extensively used for heating photographic laboratory trailers, *Air-portable* photographic tents, map reproduction trailers and similar equipment. They are also adaptable for use in heating officers' field quarters.

Among the advantages claimed for the heaters are, safe use of all kinds of gasoline, constant forced circulation of air and excellent portability of the heating unit. A unit delivering as high as 40,000 Btu per hour can be carried by one man, and occupies only about 3 cu ft of space.

The unit works as follows: The fuel is delivered to a mixing block in liquid form. It is atomized, and burned in a sealed metal

(*Continued on page* 289)

An Important Message to

Technical Men

The war has carried the manufacturing age to a new peak! Production demands have created technical problems the like of which the world has never seen before! The services of engineers are at a premium. Especially the services of one particular class—executive engineers—*engineers with business training;* engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability *now, today*—not five, or ten years from now! The shortage of such men is acute—even more acute than that of skilled production workers. And company heads, aware of this situation, are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be firmly entrenched in key executive positions when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other divisions of business—of marketing, accounting and finance. He has of necessity a vast amount of technical training and experience. But in order to grasp the opportunities that present themselves today—to assume leadership on the production front—he must *also* have an understanding of practical business principles and methods.

The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill.

FREE help for engineers

Ever since the war began, there has been an unusually heavy demand on the part of our technically-trained subscribers for the Institute's special guide on "How to Prepare an Engineering Report". Extra copies of this practical, helpful 72-page Guide are now available and, for a limited time only, will be sent free to all technical men who use the coupon at the right.

134,000 men on the operating side of business have enrolled for this training. More than 37,500 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our huge war industries.

This training appeals to engineers because it gives them access to the thinking and experience of the country's great business minds. It is especially valuable to such men because it is basic, not specialized—broad in scope, providing a thorough groundwork in the fundamentals underlying *all* business. It covers the principles that every top executive must understand. It applies to all types of industrial organizations, because all types of organizations are based on these same fundamentals.

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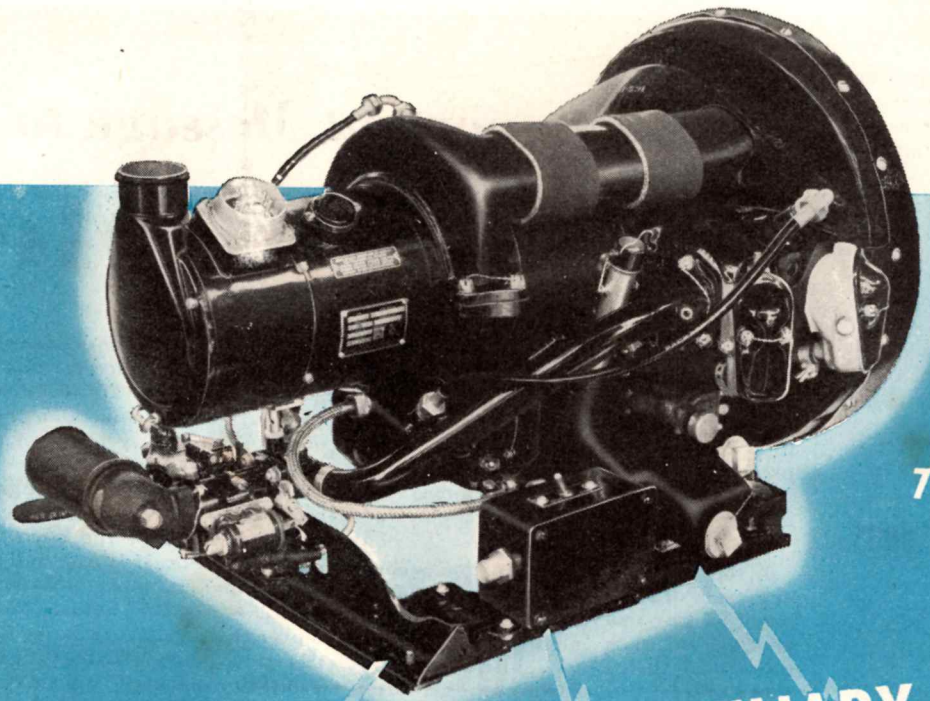

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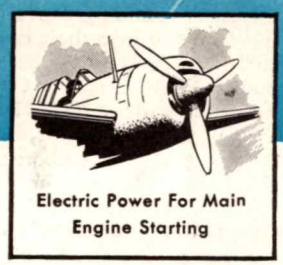

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POWERFUL—This 15 horsepower, two-cylinder engine, possessing the built-in margin of dependability that is a feature of every Lawrance Auxiliary, has a continuous power rating of 5 KW, plus a considerably higher overload rating. High operating R.P.M. insures vibration-free performance.

VERSATILE—Serving aboard aircraft and tanks of America's fighting forces, the Model 20A supplies electrical power for the operation of gun turrets, radio, bomb hoists, and other vitally important accessories.

Lawrance

"THE AUXILIARY POWER PLANT THAT'S BUILT WITH AIRCRAFT ENGINE PRECISION"

LAWRANCE ENGINEERING AND RESEARCH CORPORATION • LINDEN, NEW JERSEY

(*Continued from page* 287)
chamber, the only opening being an exhaust at the end opposite the mixing block. Metal fins on the cylindrical chamber speed radiation of the heat, and a small electrically driven blower distributes heated air at an efficient velocity. A flexible tube connects the exhaust opening to the outside atmosphere. Blowers operate on either 110-v or 6-v circuits.

The company also has developed an automatically-controlled water heater, employing the same gasoline heating unit which is said to have the capacity to heat 10 gal of 60° water to boiling temperature in 15 mins.

•

The illustration shows clearly the compact and self-contained character of these units. The unit shown is rated at 12,000 to 25,000 Btu per hour and 200 cfm circulation yet it weighs only 47 lbs and occupies less than 2 cu ft of space. The heat directing hood fits four ways and may be connected to ducts.

Hunter & Co., Cleveland, Ohio

ELECTRIC HAND GRINDING TOOL

AeroED 1862 (Sept. 1943) . . .

High-speed shop tool for grinding steel of any characteristics, and cutting non-ferrous materials.

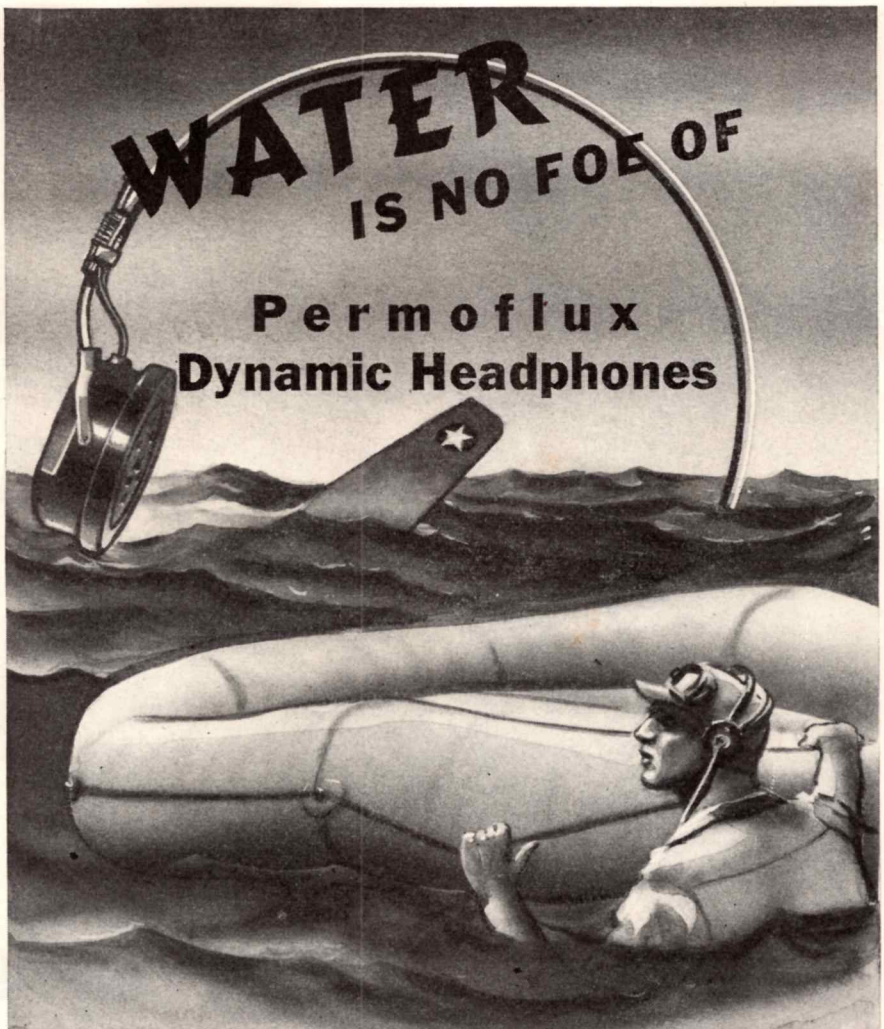
The machine runs at 35,000 rpm under load and develops 1/6 hp at full load. It has a plastic case which is light in weight and provides safety from electric shock. An overload switch protects the motor from abuse on a-c, and will stop the tool when the operator applies excess pressure as a reminder that speed does the job, not pressure.

There is an automatic brush stop that stops the brush when nearly used up so

that the brush spring will not hit the commutator. The four ball bearings used in the tool are sealed within a reservoir of high-speed lubricant to keep dirt and grinding grit out of the bearings.

An attachment called the *Coolflex* flexible shaft converts the unit into a flexible shaft machine. This attachment is equipped with a small fan that takes in cool air through the handle and blows it over the

(*Continued on page* 291)



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Because of their special hermetically sealed design, the outstanding performance of Permoflux Dynamic Headphones is not impaired by water, moisture or long hours of corrosive salt spray. And yet this same unique design allows instantaneous pressure difference compensation — an important, exclusive Permoflux development that assures higher sensitivity, more uniform frequency response and improved intelligibility at all altitude levels.

Permoflux craftsmen are turning out Dynamic Headphones in increased quantities for fulfillment of vital communications assignments.

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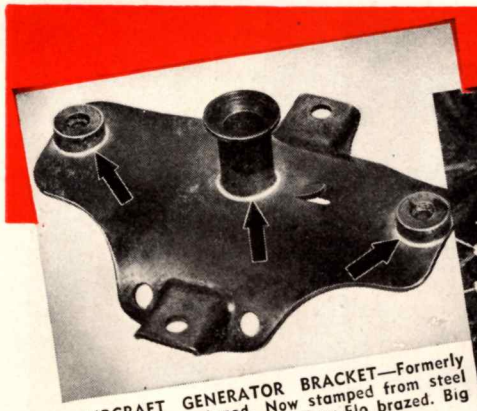
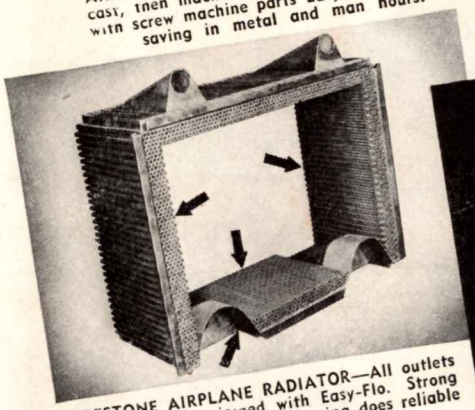


AIRCRAFT GENERATOR BRACKET—Formerly cast, then machined. Now stamped from steel with screw machine parts Easy-Flo brazed. Big saving in metal and man hours.

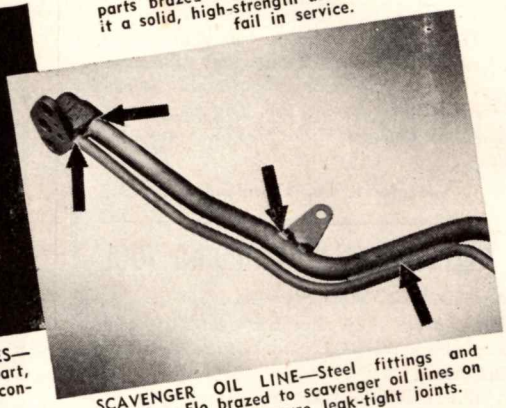
RADIO IGNITION SHIELD—Brazed joints must withstand vibration, shock, wide temperature variations. That's why Easy-Flo is specified throughout.

LINK TRAINER SPIN TRIP CONTROL—All parts brazed together with Easy-Flo—making it a solid, high-strength unit which will never fail in service.



PRESTONE AIRPLANE RADIATOR—All outlets and frame work joined with Easy-Flo. Strong evidence that silver alloy brazing does reliable work.

COOLANT ELBOW FOR AIRCRAFT ENGINES—A simple, Easy-Flo braze on an aircraft part, typical of hundreds used in aircraft construction.



SCAVENGER OIL LINE—Steel fittings and clips Easy-Flo brazed to scavenger oil lines on aircraft engines assure leak-tight joints.

EASY-FLO is helping to "give the gun" to aircraft production

Illustrated are just a few of the literally hundreds of metal joining jobs in the aircraft field that are being done faster and better with the low-temperature silver brazing alloy EASY-FLO. . . . In providing the means for producing strong, vibration and shock resistant joints with unequaled speed and reliability, EASY-FLO is making a noteworthy contribution to the war effort throughout all industry. . . . Get full EASY-FLO details in Bulletin 12-A.

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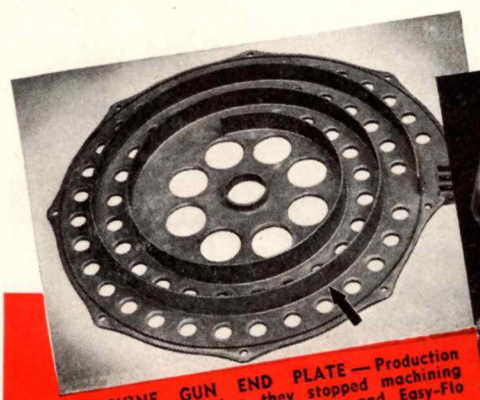
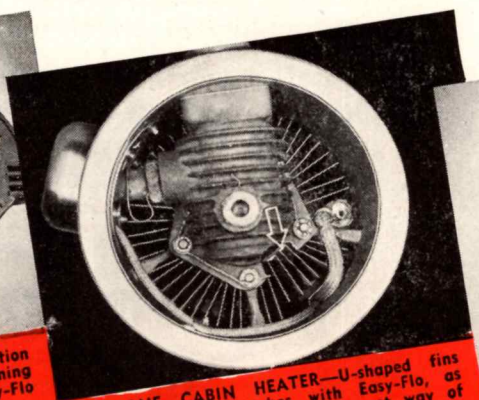


MACHINE GUN END PLATE — Production jumped 500% when they stopped machining this part from heavy forgings and Easy-Flo brazed spiral strips to stamped plates.



AIRPLANE CABIN HEATER—U-shaped fins joined to heating tubes with Easy-Flo, as shown by arrow. A rapid, low-cost way of doing the job.

MICRO-SWITCH HOUSING — Production increased from 500 to [illegible] housings daily when they switched to high-speed brazing with low temperature Easy-Flo.

(*Continued from page* 289)
working tool. Both the machine *Precise-35* and the attachment can accommodate tools with shanks up to ¼-in diam mounted wheels up to 1¼-in diam and milling cutters up to ⅜-in diam.

•

The illustration shows the tool with a flexible shaft attachment at work on the fins of an air-cooled engine cylinder. It constitutes a fine piece of accurate engineering and can touch up transmission gears, finish an aluminum pattern and do a hundred types of delicate jobs.

Precise Products Co., 1328 Clark St., Racine, Wis.

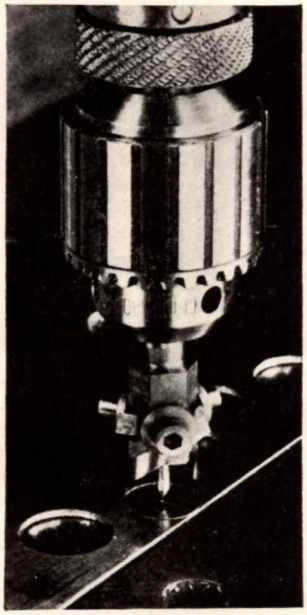
ADJUSTABLE HOLE CUTTER

AeroED 1863 (Sept. 1943) . . .

Three-blade adjustable hole cutter equipped with a retractable lead drill, which has been found satisfactory for multiple setups.

It is said that the cutter will stand the wear and strain of heavy drill press operation and is well suited for use in portable air motor drills. The hole cutter cuts precision holes from ½-in to 5-in diameter and up to 1 in thickness of metals, plastics, hard fiber, pressboard and on uneven surfaces. Sizes are available for use in hand drills, pneumatic motors, milling machines, drill presses and lathes.

The cutter eliminates the necessity for boring and reaming a hole because of the precise, clean out it produces on the first attempt. Shank of the tool is heat-treated. The three tool bits are made up of high-

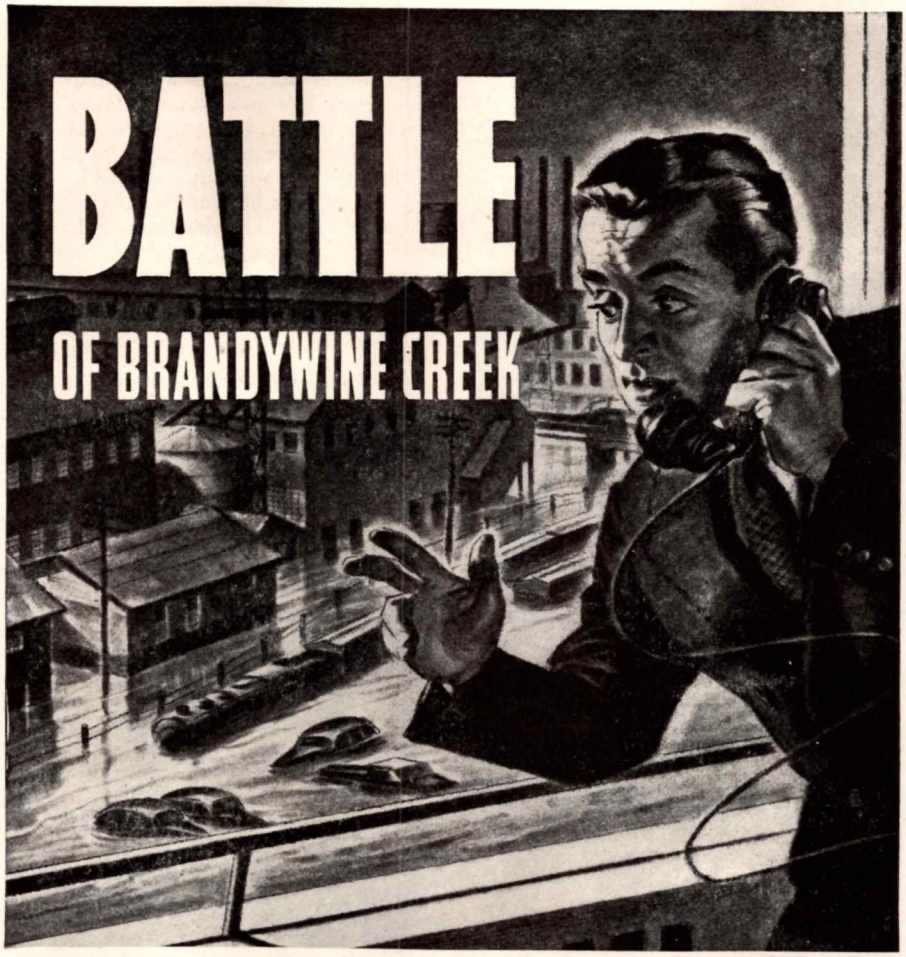


speed steel, precision ground. The hardened and ground pilot can be removed so that a lead drill may be used in drill presses. The hole cutter is simple to set, requiring only a steel rule for measuring the distance from pilot to tip of blade.

Seven models are available, each embodying different features and designed for various types of work.

•

For line production, the cutters are available with pointed retractable pilots which require no pilot holes in the work—merely a



On August 9th, 1942, Brandywine Creek overflowed its banks and flooded the property of the Lukens Steel Company in Coatesville, Pennsylvania. After the waters receded, in addition to the immediate danger of a serious epidemic, months of man-power delay were threatened in this, the home of the world's largest plate mill, because of filth, muck and mud. Trouble shooters of the West Disinfecting Company helped to prevent this delay. Roadways, buildings and material were thoroughly disinfected. Drinking fountains were made sterile and even files and records were salvaged. All this was started less than one hour after the flood had receded . . . and sick absenteeism was prevented almost completely.

West's Regular Service, While Less Dramatic, Is No Less Important.

Each year, for example, dermatitis (disease of the skin) is responsible for millions of hours lost from work by men and women in American industry. West supplies industry with hand cleaners, protective creams, disinfectants and other products that help protect workers against this production-wasting scourge.

Send for this new FREE booklet "Production Safeguards Against Dermatitis." It may help you determine the possible causes of dermatitis in your plant.

*Trade Mark Reg. U. S. Pat. Off.

55 BRANCHES • HELPING TO GUARD INDUSTRIAL HEALTH • COAST TO COAST

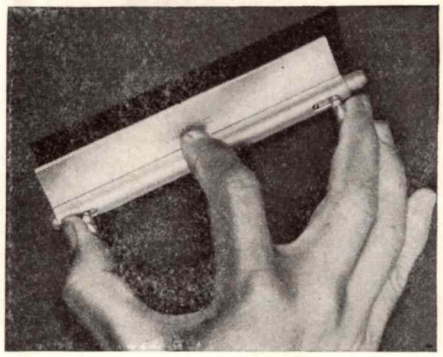
WEST DISINFECTING Company

42-16 WEST STREET • LONG ISLAND CITY • N. Y. • DEPT. AO

center punch marking. The ease of adjustment and the subsequent precision are impressive.

Robert H. Clark Co., 3424 Sunset Blvd., Los Angeles, Calif.

QUICK RELEASE HINGES



AeroED 1864 (Sept. 1943) . . .

New quick release hinges.

The new hinges are adapted to quick removal of hinged doors, map or chart tables, seats in cargo planes, shelves, etc. The unit is composed of a bracket housing spring loaded attaching pins, the latter equipped with finger pads to retract the pins. When the pads are forced together, which can be done from any position, even with gloved hands, the hinged part is entirely free. The new hinges are available in several bracket designs and lengths from 2 to 6 in.

•

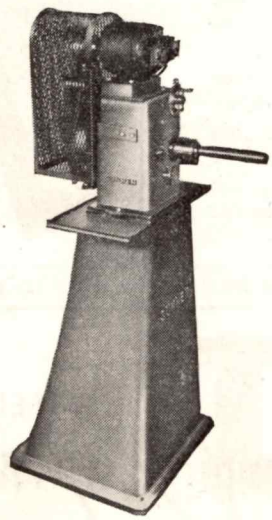
These hinges were originally used on machine gun applications. Redesigned, they are serving in a wide variety of aircraft applications.

Burklyn Co., 3429 Glendale Blvd., Los Angeles, Calif.

PRECISION HONING MACHINE

AeroED 1865 (Sept. 1943) . . .

Precision honing machine handles a wide variety of internal honing jobs in aviation plants.



The new machine speeds up internal honing jobs, maintains greater accuracy and tolerances down to 2 micro inches are held on a production basis. The new precision hone handles such parts as aircraft valve guides, wing brackets, hydraulic brake cylinders, piston pins, valve tappet rollers and instrument panel control wire bushings.

Other items in which it has been used include pump shaft bushings, carburetor idler pumps (blind hole), hydraulic control valves, Bakelite carburetor metering jets, altitude control valve seats, spur gears and drawing dies. The machine handles any internal diameter from .185 in to 2.625 in.

•

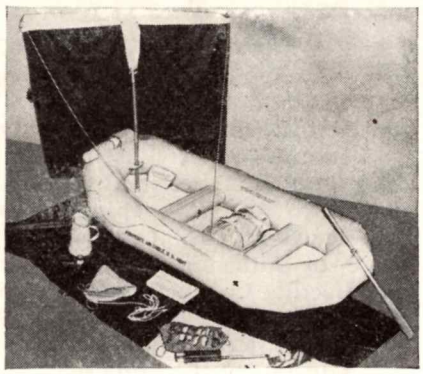
The greater accuracy spells better performance, reduced maintenance costs and longer life. The new hone is of decided value in aircraft manufacture.

Sunnen Products Co., 7945 Manchester Ave., St. Louis, Mo.

5-MAN RUBBER LIFEBOAT

AeroED 1866 (Sept. 1943) . . .

A rubber boat, well-equipped for any emergency, contains two tarpaulins, one for a sail and another for camouflage or to catch water; two long oars to keep the sail upright and spread out; a short steering car; a sea anchor; a bailer; a repair kit; a gas cylinder to inflate the boat; a pump to inflate the boat if punctured; a signal kit;



seven water cans; three sea markers; nine type K rations; a flashlight; a knife; a whistle; a first aid kit and a fishing kit. When packed the boat with its equipment occupies little space.

•

The 5-man boat shown looks workmanlike and trim. Even the foregoing list does not exhaust the equipment carried. Since bullethole plugs, rubber cement, patches, sandpaper, pliers, scissors and other items are carried.

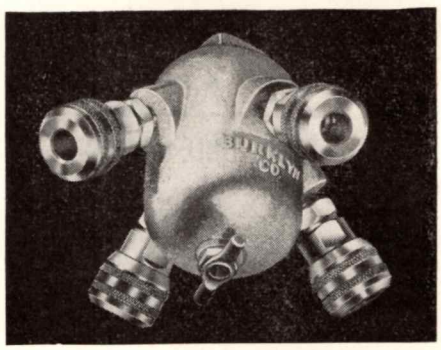
General Tire & Rubber Co., Akron, Ohio

FOUR-WAY AIR MANIFOLD

AeroED 1867 (Sept. 1943) . . .

Four-way air manifold used in all types of plants.

This manifold is of the ceiling suspension type, and accommodates up to four air hoses.



It has the added advantage of being a water trap and drain to reduce the moisture from compressed air reaching the air tools or jet outlets. The manifold may be used with quick detachable hose fittings as shown, or with straight screw-in connections. The intake is ½-in pipe thread and the four outlets each ¼-in pipe thread.

•

The manifold has found many applications in aircraft shops in sandblasting, spray painting and similar operations.

Burklyn Co., 3429 Glendale Blvd., Los Angeles, Calif.

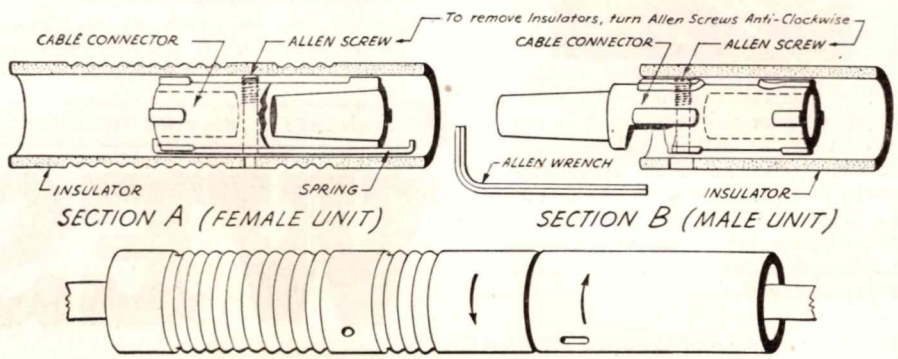
ARC WELDING CABLE CONNECTOR

AeroED 1868 (Sept. 1943) . . .

Fully insulated cable connector that locks tight and quickly unlocks for use in arc welding. (Illustration below).

The female section of the cable connector is soldered to the cable lead. The male section is soldered to the cable extension. Removable insulators are securely held in position with *Allen* screws. Connection is made by inserting the male section into the female section. Then, with a twist, the locking spring rides the cam into position holding both sections tight.

The sections are unlocked by simply twisting them apart. The female section, when installed on a cable lead, may also be



used as a holder handle and connected directly to the Stinger end of a *Jackson* model TA holder. This adaptation saves time, material, eliminates the danger of live cable ends, and makes possible the economies of standardization.

•

The connector, known as the Quick-Trik *seems to justify its name.*

Jackson Products, 3265 Wight St., Detroit 7, Mich.

NAVIGATIONAL INSTRUMENT

AeroED 1869 (Sept. 1943) . . .

Navigator combines the functions of the automatic radio direction finder and the directional gyro and integrates the indications of these two basic instruments.

The new instrument automatically gives the pilot a continuous graphic solution to many navigational problems and he de-

termines at a glance not only his present position and heading, but also how his position and heading are changing with respect to his ground reference and desired track.

It simplifies straight-line navigation toward or away from a radio transmitter station under varying drift conditions and without visual reference outside the plane. The navigator also facilitates rapid position fix and straight-line navigation to any destination not provided with a radio beam transmitting station.

•

The Learnmatic Navigator *as it is called is finding useful service in the difficult proving ground of wartime and should be equally useful in the post-war period.*

Lear Avia, Inc., Piqua, Ohio

AUTOMATIC RIVET BUCKER

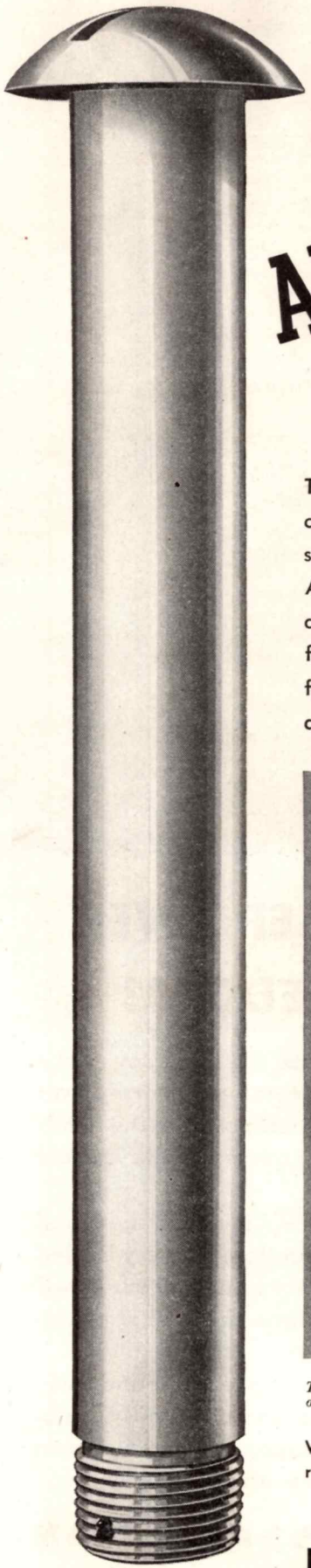
AeroED 1870 (Sept. 1943) . . .

Bench model automatic rivet bucker permits bucking and riveting in one operation.

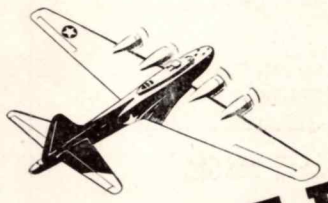
The new tool uses a standard rivet set that is synchronized with an air-cushioned bucker. The bucker is always perfectly aligned with the rivet set and eliminates the inaccuracies and labor required with manual control.

Treadle control enables the operator to have both hands free with resulting increase of speed in production. When the rivet set

(Continued on page 295)

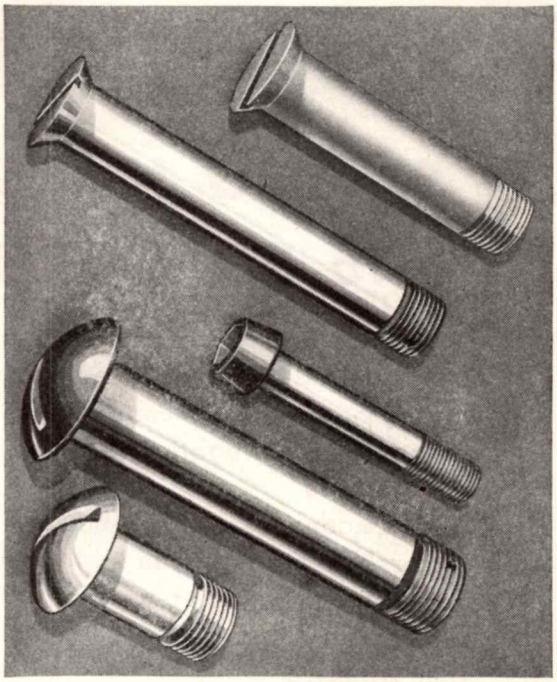


Clevis Bolt for landing gear of heavy aircraft (actual size).



AIRCRAFT BOLTS BY RITCO

To meet the exacting requirements of today's Aircraft Industry, we are proud to be able to supply special bolts in the larger sizes. Furnished to AN Aircraft Bolt Specifications or NAS Close Tolerance Specifications, etc. These bolts are manufactured of Aircraft Alloy or High Carbon Steels from 9/16" to 1¾" diameter . . . special heads as specified.



Typical Aircraft bolts produced by RITCO. Shown are samples of 82° Angle Bearing Bolts, Internal Wrenching Bolts and Clevis Bolts.

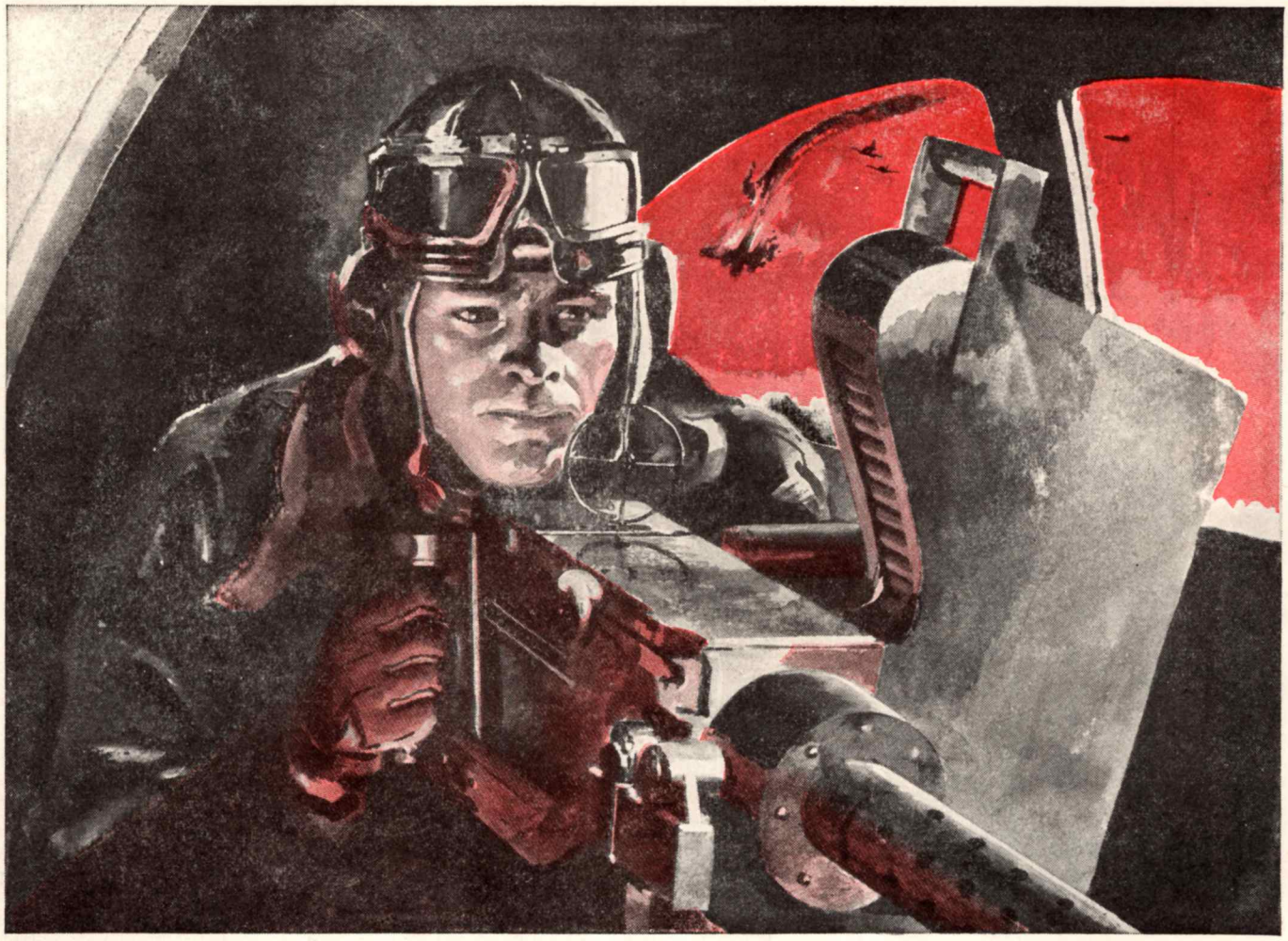
We shall be pleased to quote on your special aircraft bolt requirements.

◆

RHODE ISLAND TOOL COMPANY

148 W. River St., Providence, Rhode Island

Serving American Industry since 1834



SAVING HORSEPOWER *to* SAVE FREEDOM!

BOILED right down to basic facts, it's horsepower of a hundred kinds that's deciding this war... horsepower giving mobility and meaning to the firepower in the hands of the American fighting man, who grew up with his foot on a throttle.

An unconquerable combination—American men and motors! It's an honor and an inspiration to every Sealed Power man and woman to serve every branch of our armed forces with the products that have won the trust of peacetime America.

Sealed Power Aircraft Piston Rings, through sound basic design, carefully controlled materials and rigidly maintained precision standards, offer important advantages in safeguarding power and saving precious fuel.

SEALED POWER CORPORATION

Muskegon, Michigan • Windsor, Ontario

★ ★ ★ ★ ★

BUY AT LEAST ONE EXTRA $100 WAR BOND THIS MONTH

You owe it to yourself—to America—to that special man of yours in uniform

★ ★ ★ ★ ★

SEALED POWER PISTON RINGS

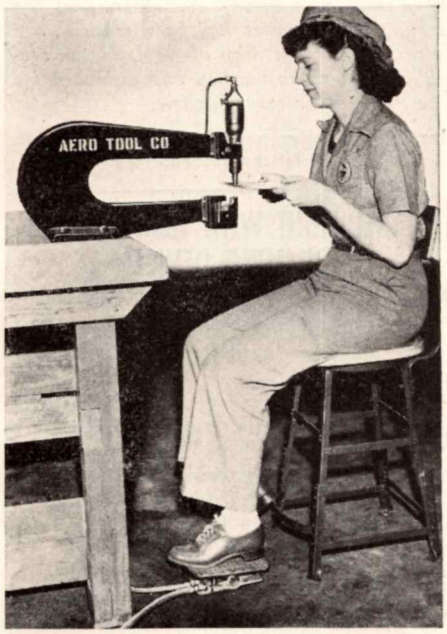
SCRAP METAL IS NEEDED FOR EVERY GUN, TANK AND SHIP. SEND *YOUR* SCRAP TO WAR.

PISTON RINGS—PISTONS—CYLINDER SLEEVES

(*Continued from page 293*)

contacts the rivet, the bucking bar is always against the shank and no pre-determined setting is required even with varying lengths of rivets.

The yoke is made of ⅜-in hot-rolled steel and is stressed to prevent deflection. The new bench bucker has a 15-in throat but other sizes are available. An easily installed



button type gun is used and bucker can be supplied with or without gun. All parts other than the yoke are interchangeable with the portable model.

•

The photograph emphasizes the compact and clean design of the new tool which reduces operational difficulties to a minimum.

Aero Tool Co., 233 W. Olive Ave., Burbank, Calif.

NEW A-C ELECTRODE

AeroED 1871 (Sept. 1943) . . .

New all-position electrode designed especially for use with a-c transformer welding machines.

The electrode is suited for all mild steel applications and is available in the usual sizes of ⅛, 5/32, 3/16, ¼, and 5/16 in, and 14 and 18 in lengths, packed in standard 50-lb containers.

•

Designed and constructed by a company having long experience in industrial welding equipment.

Harnischfeger Corp., Milwaukee, Wis.

STAINLESS STEEL IGNITION CABLES

AeroED 1872 (Sept. 1943) . . .

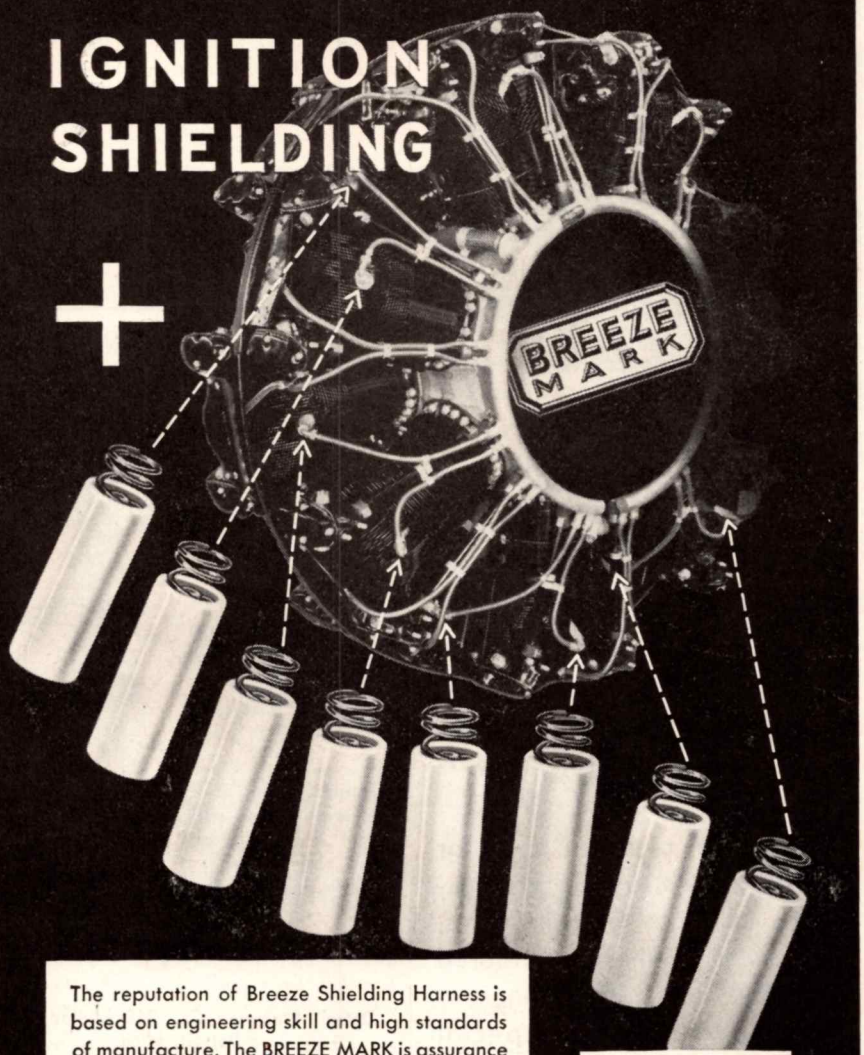
New line of stainless steel ignition cables used in the manufacture of airplanes.

It is claimed that a 7-strand Steelductor high tension cable frequently replaces the conventional 19-strand copper conductor. Advantages of the 7-strand Steelductor in a shielded circuit for aircraft ignition are said to be its lower capacitance and higher voltage delivery. The Company reports that tests

Breeze

IGNITION SHIELDING

+



The reputation of Breeze Shielding Harness is based on engineering skill and high standards of manufacture. The BREEZE MARK is assurance of dependable shielding for aircraft engines.

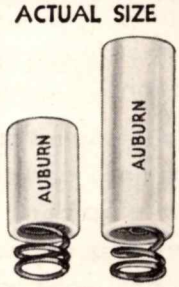
Auburn
CERAMIC SPARK PLUG CONNECTORS

Breeze Corporations Inc. have tested and approved Auburn Connectors for equipment on their Harness. We are proud to join Breeze in providing constant contact between Ignition Cable and Spark Plug with Connectors that do not carbonize or carbon-track; that have high dielectric strength and do not absorb moisture.

Write us for information.

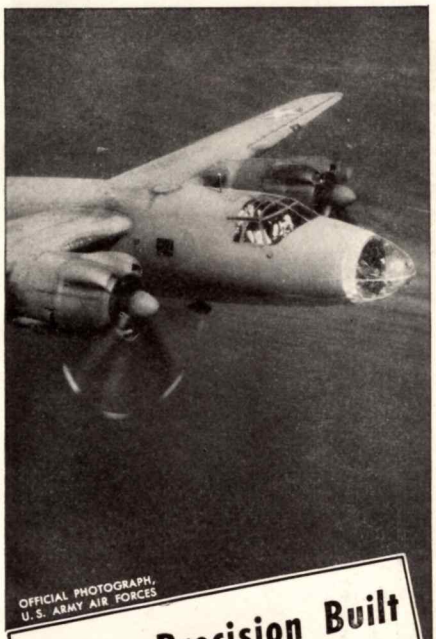
AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark 2, N. J.

ACTUAL SIZE



No. 1041 — 9/16"
No. 1099 — 1"

AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE and FACTORY, AUBURN, N. Y.



Where Precision Built Parts are Vital

THE precision with which a plane roars through the sky has its beginning in many widely separated plants, turning out small parts and special equipment.

Production of small parts for aircraft needs, accurately machined to exact measurements, is a service FENN has rendered for many years. Their long experience in building special machinery has given them a sound knowledge of design and production.

Keep the name FENN in mind for machines and tools, design and development, and sound engineering counsel when the world once more turns to industrial peace-time projects in the days ahead.

FENN

THE FENN MFG. CO.
HARTFORD, CONN.
ESTABLISHED 1900

indicate that a 4-ft shielded length of steel conductor cable not only delivers 25% more voltage, but during starting of an engine and before ignition provides a series of spark discharges so as to improve starting performance.

At critical points such as very high and low speeds, the "Steelductor" will produce a spark where conventional 19-strand copper cable fails to function. In addition to providing fuel economy through a delivered spark of longer duration, the lower capacitance steel cable reduces radio interference and prolongs spark plug life.

•

Many combat aircraft are equipped with these cables, and the electrical experts of the aircraft industry appear to agree that the cables have decided advantages.

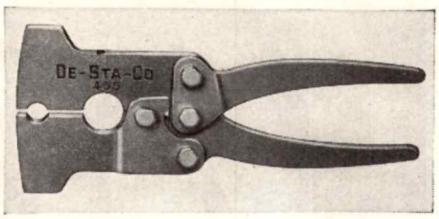
Electric Auto-Lite Co., Port Huron, Mich.

TOGGLE PLIERS

AeroED 1873 (Sept. 1943) . . .

Toggle pliers designed for holding piping tubes, rods or other cylindrical parts during manufacturing operations.

These pliers, No. 455, lock into position and hold securely at any point within their



gripping range, and are easily and quickly released. They will hold any cylindrical object from ½-in to 1¼-in od. For holding other sizes these cylindrical toggle pliers are bored and slotted to order.

•

A glance at the illustration will make it at once apparent why a difficult shop problem has been really solved by these pliers.

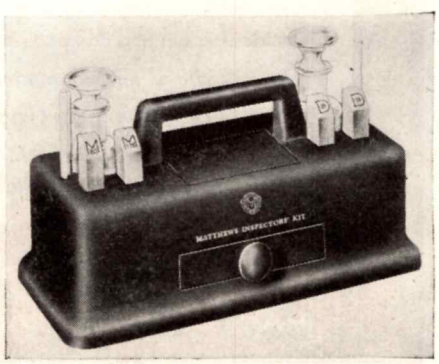
Detroit Stamping Co., 368 Midland Ave., Detroit, Mich.

ETCHING STAMP KIT

AeroED 1874 (Sept. 1943) . . .

Compact inspectors kit, containing stamps used with and unaffected by acid etching inks.

The kit is made of acid-proof, non-critical material, and holds four stamps. Acid etching ink is kept in one bottle and neutralizer in another. In the front of the unit is a stamp pad contained in a drawer. The cover closes automatically and does not allow the acid fumes to escape.



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Leaving nothing to the imagination, we will add that the inspector chooses the desired stamp, tilts the self-closing cover on top of the kit and inks the stamp by touching the pad underneath. When the stamp is inked and withdrawn, the cover does its work. After the part has been marked, the inspector places a drop of oil from the second bottle on the marked impression. A kit like this will be very welcome.

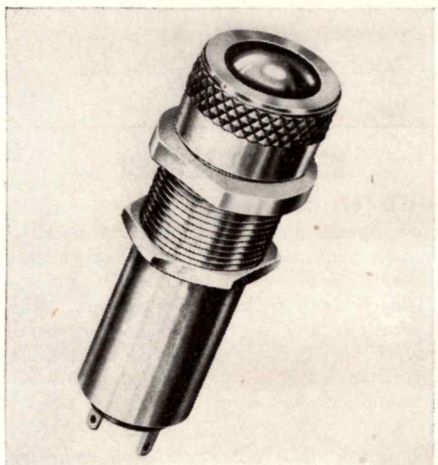
Jas. H. Matthews and Co., 3942 Forbes St., Pittsburgh, Pa.

PANEL LIGHT WITH TESTING AND DIMMING DEVICE

AeroED 1875 (Sept. 1943) . . .

Panel indicator light with a self-contained testing and dimming device and a break and make circuit.

As shown in the photograph, the light is tubular in construction and is made to any required diameter above ⅝ of an inch to meet panel mounting requirements. It comes in barrel lengths of 1½ to 2 in and overall lengths of 2 5/16 to 2 13/16 in. It is also made for either conduit or box mounting connections and can be furnished with either a fixed or rotating jewel and with or without the break and make circuit. The "built-in" testing and dimming machanism eliminates the need for switches, rheostats, and the wiring that goes with them. Dimming is controlled through the use of a rotating jewel assembly, which adjusts shutter openings, or the alignment of polarized



jewels—when they are used—to any desired intensity of light. The burn-out testing device is equally simple in its operation.

The light is designed to carry current from three sources—ground, control circuit, and the "hot" or regular ship's lighting system. Current from the control circuit, which operates the ship's various mechanisms and the panel indicator lights, of necessity flows to the lamp and bulb of the light at all times. The "hot" current reaches the lamp and bulb only when pressure (finger-tip pressure being ample) is applied to the jewel assembly. If the bulb fails to light when it is brought into contact with the hot

current by pressure on the jewel assembly, the pilot or operator checking his indicator light knows at once that the bulb, and not the operating unit, is at fault. The light is so constructed that the bulb can be quickly and easily removed and replaced, saving time when seconds are important. There are two models of the light available: S.A.I. 101 and 102. The latter is equipped with a break and make circuit to prevent the actuation of solenoids, relays, etc. Both models can be made with either aluminum or plastic parts.

•

The Panel light is being marketed as the "Tell-Tale" testing light, and its ingenuity is matched by its effectiveness. It will save both pilots and maintenance men much trouble.

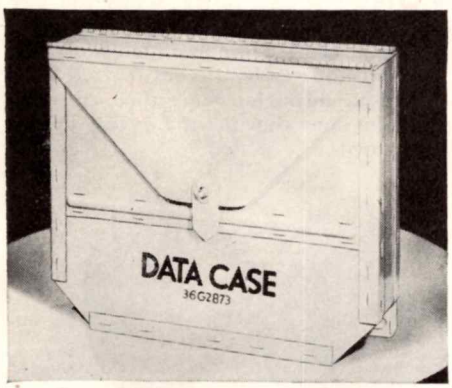
Searle Aero Industries, Inc., Orange, Calif.

PLASTIC DATA CASE

AeroED 1876 (Sept. 1943) . . .

Light, durable data case, made of laminated plastic stitched with steel.

The new data case has an ingenious fastening which is operable with one hand and



the cover is so sprung that when unfastened, it remains open. The case is sprayed with two coats of high-gloss, moisture-resistant durable lacquer.

•

The illustration gives an impression of neatness and strength.

General Aviation Equipment Co., Inc., Ashley, Penn.

PREPARING METAL SURFACES FOR METALLIZING

AeroED 1877 (Sept. 1943) . . .

Electric bonder unit for preparing hardened metal surfaces for metallizing.

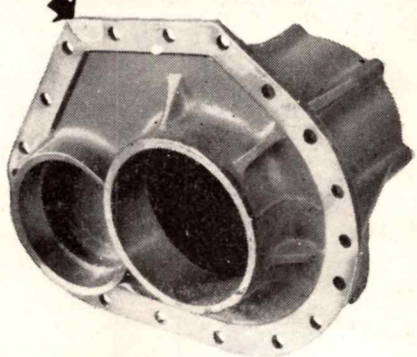
The unit operates on 220 v, 60 cycle line. A patented aircooled electrode holder permits high speed bonding without danger of overheating, pre-hardening or distortion. It eliminates guesswork in preparation, the necessity of a lathe, and carbon ring characteristics. The unit was developed originally to prepare heat treated surfaces for metallizing but is said to work equally well on all metals and is practically as fast as rough threading. The bonder is built for long and rugged service, and is easy to operate. The

(*Continued on page* 299)

Castolin Eutectic*

EUTECTIC
(Means Lowest Binding Alloy)
LOW TEMPERATURE WELDING

SALVAGING DEFECTIVE ALREADY-MACHINED CASTINGS



WITH MACHINABLE-EUTECTIC "COLDARC" ALLOY No. 24

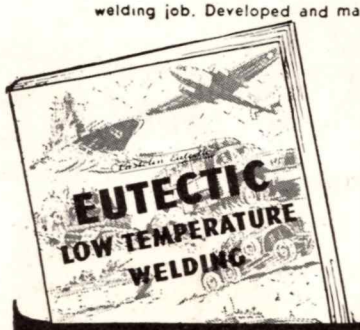
PROBLEM

Salvaging already-machined cast-iron, malleable iron or chrome-nickel alloy steel castings having porous spots or machining errors. . . . When ordinary electrodes were used a hardened fusion line generally resulted. Naturally, this caused great difficulty and time-waste in machining the welded sections.

SOLUTION

Eutectic "Coldarc" Alloy No. 24 (AC-DC). This new kind of electrode can be applied at low heat —without preheating—without deep fusion of the parent metal. Eutectic "Coldarc" Alloy No. 24 gives perfectly *color matching*, *easily machinable* welds on all ferrous metals. It has been saving hundreds of thousands of dollars in foundries, tool shops, ordnance plants, etc.

Only "Eutectic* Alloys" are the true Low Temperature Welding Alloys that are revolutionizing production welding, maintenance welding and salvaging in war plants throughout the nation. There are 42 specialized rods for every metal and every welding job. Developed and manufactured only by Eutectic Welding Alloys Company.
*Reg. U. S. Pat. Off.



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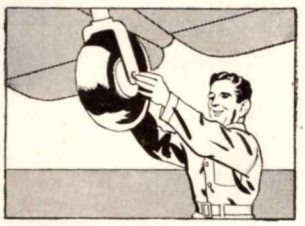
THE GENERAL WAY*

The Old Way . . . tires, tubes, wheels bought as separate units require extra warehousing space, extra inventory and stock records.

The Old Way . . . means lost time in obtaining needed tail wheel units from separate storage spaces.

The Old Way . . . necessitated assembly of tail wheel units —waste motion!



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The General Tire & Rubber Company's *complete* ahead-of-the-field line of military and commercial type tail wheels is backed by General's long, practical experience in the manufacture of aircraft wheels, brakes, tires and allied aviation products . . .

General tail wheels are *rugged,* built to take as much abuse as main landing wheels . . . yet they're *light—for increased payload!*

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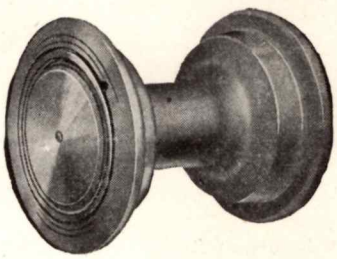

GENERAL Military and Commercial type tail wheels are fabricated from aluminum or magnesium alloy castings. Precision machined . . . fitted with tapered roller bearings. Both tapered and straight axles. Designed and built to A. A. F. Spec. No. 25272. (Easily removable dust-proof cover equipment.)

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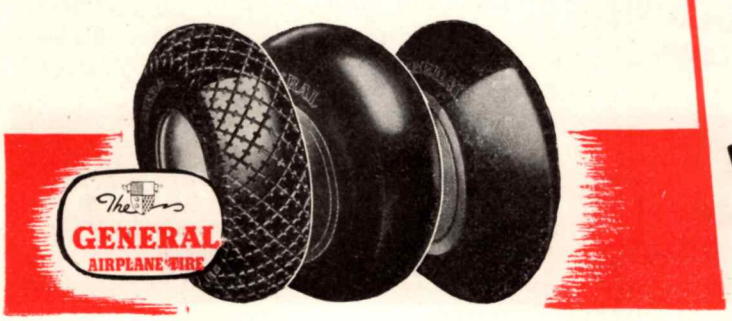


NOW! **You Can Determine Correct Aircraft Tire Pressure in Just 60 Seconds . . . with the GENERAL DEFLECT-O-GAUGE**

With the General Deflect-O-Gauge, each tire can be inflated to exactly the *correct pressure* required for the load. No graphs, charts, use of scales or air pressure gauges necessary . . . simply use the General Deflect-O-Gauge and air hose! Write now for free instruction folder—Address: Aviation Division, The General Tire & Rubber Company, Akron, Ohio.

(*Continued from page 297*)

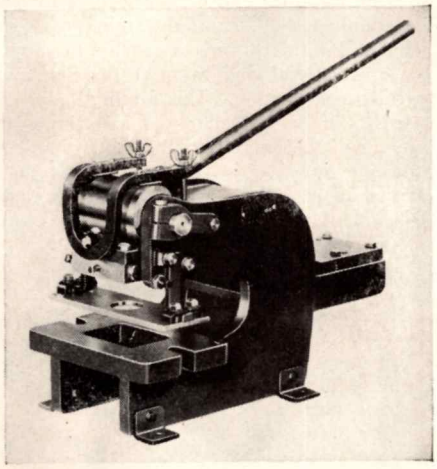
procedure can be learned quickly by any operator without any special knowledge of electric current or arc welding.

•

Studying the illustration of a well prepared booklet we see an air-cooled electrode holder, with the heat controlled by one dial in front of the machine. The operator can control the density of metal deposit by controlling air pressure and therein lies one of the secrets of success.

Metallizing Company of America,
1330 W. Congress St., Chicago, Ill.

HAND PUNCH PRESS



AeroED 1878 (Sept. 1943) . . .

New hand-operated punch press which obtains positive die alignment without leader pins, slides or ways.

The new punch press takes simplified dies, or standard dies of the type used on most small power presses and has capacity to blank a 2 in diameter hole in 10 ga. mild steel. The new press has a 4 in by 4¼ in punch plate with means for accommodating even larger dies and a wide cam with bearing entirely across the die. This permits eccentric loading, or in other words eliminates the need for centering punches laterally on the punch plate. The new press has a universal aligning which is mathematically accurate to .0001 in.

•

Even in these days of high production, experimental or modification work needs hand tools. This hand punch press is well suited for short production runs on large sized sheets.

Leslie Welding Co., 2943 Carroll Ave.,
Chicago, Ill.

LIGHT PRESSURE SKIN FASTENER

AeroED 1879 (Sept. 1943) . . .

New skin fastener, which locks with fingertip pressure.

No pliers or guns are needed with the new holder shown in the photograph which requires only 8 lb pressure to lock and is designed for both flush and countersunk rivet applications. The fastener cannot loosen or fall off the job. Removal by means of pressure on a thumb trigger requires

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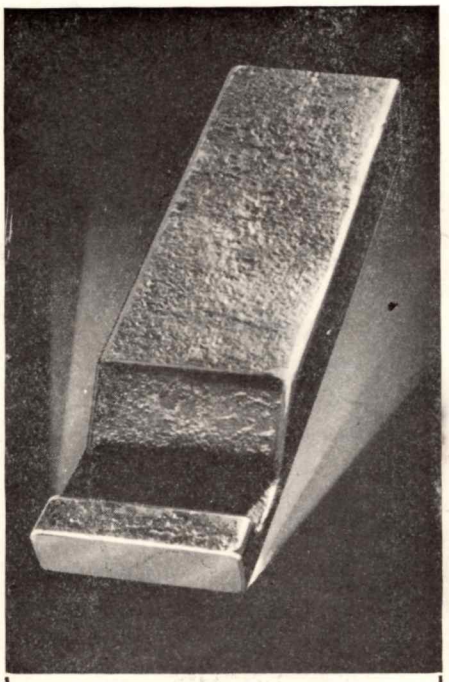

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BUCKING BARS
SPEED UP
PRODUCTION

•

BUCKING bars are widely used by practically all metal airplane and sub-assembly manufacturers to speed and improve riveting operations.

At Central, bucking bars are carefully made from a special analysis cast steel in its own foundries and finished complete, by skilled workmen, in its own plants. From start to finish facilities enable Central to guarantee high quality and fast service at all times. Central can furnish either standard stock bars or manufacture exactly to customer's requirements from their own blue prints.

Let Central figure on your needs.

•

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COMPANY
BUCKING BAR DIV.
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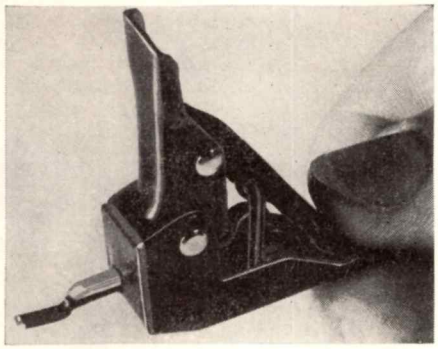
about 6 lb pressure and the operator maintains his hold on the handle for instant removal when it snaps open.

The main part of the fastener is a torsion spring made of hot drawn oil-tempered wire. This spring exerts a direct pull of 35 lb at the point of contact with the skin. In addi-



tion to the time and labor saving features, the smooth surfaces make it easy on the hands. Stock sizes are $\frac{3}{32}$ in (Drill No. 40) and $\frac{1}{8}$ in (Drill No. 30).

•

The new fastener reduces the time consumed in aligning holes and clamping skin assemblies. The light pressure and simple operation make it attractive for use by women or inexperienced operators.

Clever Tool Co., 10918 West Pico Blvd., Los Angeles, Calif.

AVIATION ENGINE HEATER

AeroED 1880 (Sept. 1943) . . .

A small, portable engine heater weighing 38 pounds.

This engine heater, using high-test aviation gasoline for fuel, produces 90,000 Btu. of heat per hour. This unit has been applied to a 2000 hp aviation engine in a room kept at 20 degrees below zero and after a 15-minute "warm-up" the engine could be started.

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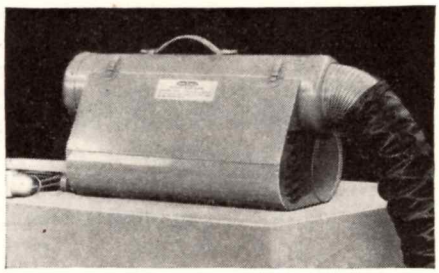
It is claimed that the new heater offers more heat per pound weight than any other



heater of its kind, and the fact that it utilizes 92% of all the heat value of the gasoline which it uses as fuel is a substantiating element.

York Heat Div., Thos. Shipley, Inc., York, Pa.

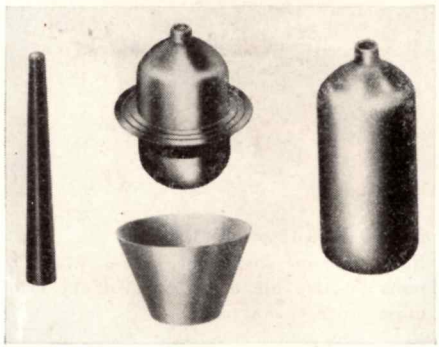
COLD DRAWING ALLOY STEELS

AeroED 1881 (Sept. 1943) . . .

New method of cold drawing high strength alloy steels solves a number of manufacturing problems.

The cold drawing of high strength alloy steels has resulted in saving thousands of tons of critical alloys employing chromium, nickel, molybdenum, etc., and released machine tools and skilled machinists for other important work. One example is the manufacture of high pressure light-weight type cylinders used for storage of carbon dioxide gas for the inflation of rubber rafts and also light-weight type cylinders used in aircraft for storage of aviators' breathing oxygen for high altitude flying.

These cylinders must, of necessity, be light in weight and yet must be suitable for working pressures of 1800 to 2015 lb psi. To obtain the necessary light weight, high strength alloy steels are used in their manufacture. Formerly, these cylinders were made from an alloy steel forging. Before closing the open end of this forging to form a seamless cylinder, the forging was machined internally and externally to remove excess material and to meet the maximum weight specification. This forging had a tare weight of approximately three times the weight of the finished cylinder. By the cold drawing process the cylinder is now cold drawn to proper sidewall thickness and the amount of alloy steel required to make the



cylinder is reduced from 50% to 60%. The cold drawn process consists of cupping from flat circular sheets or plates, cold drawing to obtain desired diameter and wall thickness, with necessary heat treatment to obtain required physical characteristics in the finished product. Careful control of tolerances of the dies and mandrels assure uniform sidewall thickness and produce a smooth cold drawn finish. By this process it is possible in many instances to eliminate machining.

There are several other good examples such as seamless cylinder housing for actuating pistons which employ leather cups or packing for the sealing medium. Another application in which machining was eliminated was the use of a seamless cold drawn high strength alloy piece of tubing as an oleo strut sleeve which is part of a landing gear mechanism on certain types of aircraft. In the aircraft field another example of the elimination of costly machining is the use of a seamless, cold drawn, hydraulic accumulator housing. By this manufacturing process and the use of high strength alloy materials, the accumulator housing meets the working pressure requirements and the maximum weight specifications and tolerances without machining. Previously it was necessary to manufacture these accumulator housings from high strength alloy forgings which were machined to meet weight specifications. There are numerous other applications where

the cold drawing of various metals solves manufacturing problems, reduces costs, saves materials and enhances the appearance of the completed unit.

•

These examples of valuable aircraft application are representative but not exhaustive.

Pressed Steel Tank Co., 1475 S. 66th St., W. Allis Sta., Milwaukee, Wis.

SAFETY APRON

AeroED 1882 (Sept. 1943) . . .

Protective apron used with success in many industries.

The "Kick-Back" apron is employed on grinding jobs as a protection when using automatic hammers, drills, etc. The apron makes use of a bowed piece of fibre underneath a heavy canvas. The back of the

apron next to the operator's body is quilted for comfortable fit.

•

The illustration makes clear the practical character of the device and the ready way in which it can be secured to the workman's body.

Industrial Gloves Co., Danville, Ill.

GUN RECOIL DAMPING DEVICE FOR AIRCRAFT

AeroED 1883 (Sept. 1943) . . .

A new aircraft machine gun recoil damping device. Known as the Machine Gun Adapter, the device was developed by engineers of Bell Aircraft in cooperation with aircraft ordnance experts of the Army Air Forces and the Navy Bureau of Ordnance nearly five years ago.

It is a portable, light-weight cradle consisting of two steel tubes and a hydraulic absorption unit and is attached to a .50 calibre aircraft machine gun in a few moments by two bolts. It adds less than an inch to the overall dimensions of a .50 calibre gun. and but three pounds to the weight when conventionally mounted. The normal recoil forces generated by a .50 calibre aircraft machine gun are so great that without a damping unit, accurate fire such as is required by turret or flexible guns in a bomber against an attacking enemy fighter, is difficult to achieve. The adapter enables the

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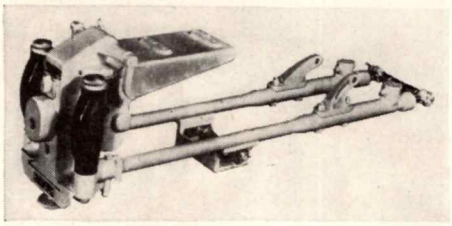
gunner to train his sights on the target and keep them there and at the same time reduces the fatigue strain on the gunner and the strength of structural requirements for mounting the gun in the airplane.

The success of the .50 calibre adapter was followed by the development of a mount for .30 calibre guns which uses a combination of springs, air cushion and friction discs instead of the hydraulic unit. Today, .50 and .30 calibre twin gun mounts are being built in addition to adapters for single guns of



these calibres. The machine gun mount for .50 calibre guns as described above is the direct outgrowth of efforts to dissipate the recoil forces of .50 calibre flexible machine guns when they were first installed several years ago in the twin engines, twin cannon Bell Airacuda. In early experiments the gun was mounted on a tubular frame on each side of which was attached a standard type automobile shock absorber. The arms of the shock absorber were then attached to the gun. The experiment succeeded and provided sufficient basic information for the design of the new small light shock units.

•

We are informed and have every reason to believe that the recoil device has increased the accuracy of our aircraft gunners considerably. The adapter has been thoroughly tested in combat and is in use on such noted aircraft as Flying Fortresses, Liberators, *Mitchell and Marauder bombers, and the new Douglas dive bombers.*

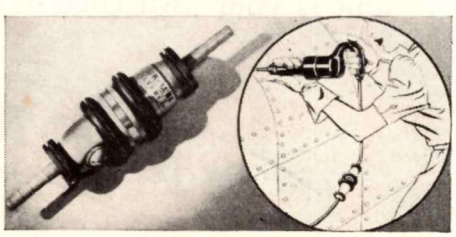
Bell Aircraft Corp., 104 W. Bellefonte Ave., Alexandria, Va.

AUTOMATIC LUBRICATOR FOR AIR DRIVEN TOOLS

AeroED 1884 (Sept. 1943) . . .

Automatic lubricator for feeding a regulated oil mist into air driven tools, thus eliminating the need for frequent daily oiling and preventing "freezing" of equipment.

The Air-Lube lubricator, as it is called, is inserted in the air hose from 1 to 6 feet from the tool, or it may be used in the air



pipes for larger air driven or semi-portable tools. A positive feeding action provides a regulated amount of oil only when the tool is operating, and the oil reservoir holds enough oil for more than a week under normal usage and a clear lucite window shows when it needs refilling. Installing the lubricator in the hose near the tool eliminates the deterioration of rubber hose lines while positive regulated wicking action with an automatic shut-off prevents any flooding of air tools with oil.

Unless otherwise specified two standard settings are provided by the factory so that operators cannot tamper with oil settings. The unit is simple to install and maintain.

•

The illustration shows the lubricating unit and how readily it may be installed in the air line of a pneumatic riveter at work on the skin of a fuselage.

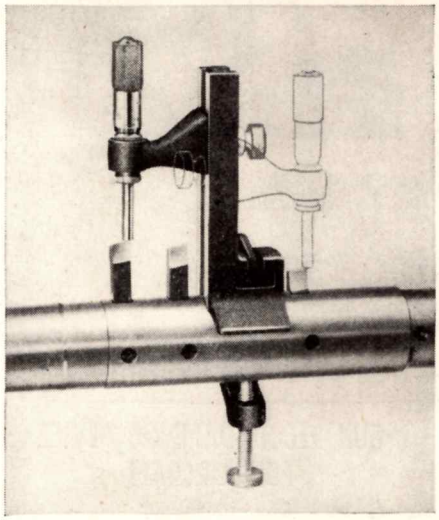
Filters, Inc., 1515 Gardena Ave., Glendale, Calif.

NEW PEDESTAL MICROMETER

AeroED 1885 (Sept. 1943) . . .

A new pedestal micrometer sets closely-spaced boring tools quickly and is useful for other gaging purposes.

The new gage consists of a pedestal having a base with a wide vee opening and flat surfaces at the ends of the extensions. With the vee groove it can be placed on a boring bar where it is held by a removable clamp engaging a slot in the top of the base. The flat surfaces enable the gage to be placed on a surface plate, a machine bed or any other plane surface from which measurements are to be made. The upright portion



of the pedestal is finished on both sides. An arm which carries the micrometer head is clamped to the vertical surface with a screw through a slot in the upright.

The new pedestal is double-faced, thus the arm may be clamped to either side as desired and can be changed from one side to the other without changing the clamped position of the pedestal. The base of the pedestal is short, permitting the gage to fit between boring tools having as little as 2-in spacing between them. Taking the overhang of the arm into consideration, boring tools placed 3½-in apart can be set without changing the pedestal, by simply clamping the micrometer head first one side and then on the other.

It is claimed that the new gage reduces setting time of boring tools to a minimum because only one trial cut is needed, after

which the tool can be reset accurately to close limits by using the micrometer. By setting the tool directly from the diameter of the bar as a reference, even the one trial cut can be saved. The flat portion of the base permits the pedestal micrometer to be used as a height gage, as a depth gage, for other machine set-ups, and for a variety of inspection work. The pedestal is a casting with accurately ground base and vertical surfaces. The arm has a ground foot and carries a standard micrometer head.

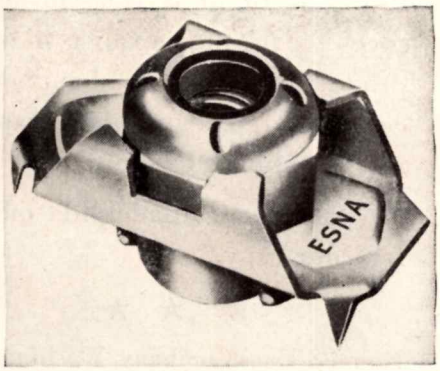
As a modification, a dial indicator reading to thousands or tenths may be substituted for the micrometer. All surfaces, except those which are ground or polished, are finished in black crackle and three clamps are furnished to fit all size boring bars from 1-in to 5-in diameter.

•

The illustration will repay a little study and gives evidence of the simplicity and rapidity of operation. It also indicates the "double-faced" character of the device.

Bartelt Engineering Co., 1412 Partridge Ave., Beloit, Wis.

STOP NUT FOR PLYWOOD



AeroED 1886 (Sept. 1943) . . .

Self-locking fastening device for use on plywood construction.

The new fastening is installed from one side of the work, providing a washer surface, and leaves the outside of the plywood surface smooth. It is strong against axial movement, independent of the thickness of the wood and requires no special tool to fix.

The combination nut-and-basket device is self-locking, so that the bolt is held secure under vibration. A regular elastic stop nut, with the red cellulose locking collar, is used interlocked with a specially contrived basket that locks into the plywood and holds the nut securely.

Four prongs at the corner of the basket sink into the surface of the plywood, and two feet inserted in the hole are forced into the wood as the nut descends, firmly anchoring the basket. Spring fingers at the top of basket clasp the nut after it is seated and hold it firm against axial play. The nut can be installed in three easy ways; driven in with a hammer, forced in with a press, or drawn in with a bolt.

After it has been applied to the surface, the nut is held against turning by four prongs on the corner of the washer plate and also by the feet that have been pressed into the sides of the hole. This construction

(*Continued on page* 305)

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(*Continued from page* 303)
makes the nut independent of the thickness of the material and it can be used on plywood from ⅛ in up. The nut is replaceable without moving the basket and 8/32 in and 10/32 in nuts are interchangeable in the same basket. A small hole, 9/32-in diameter, is all that is needed in the wood. The basket part of the device weighs only 4 ozs per 100.

•

Quantity production of plywood planes created a demand for self-locking fastenings similar to the elastic stop anchor nuts used on metal planes, and the above device has met the rigorous tests of the engineering divisions of the AAF at a time when it is greatly needed.

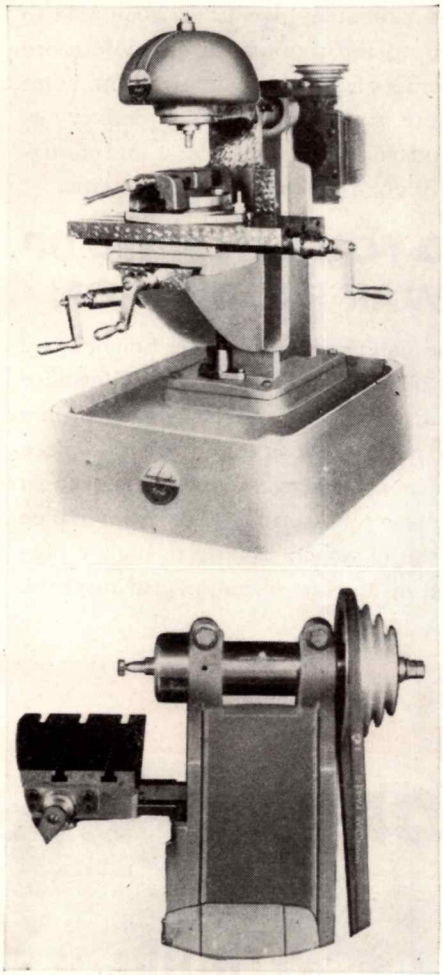
Elastic Stop Nut Corp. of America, 2332 Vauxhall Rd., Union, N. J.

QUICK CHANGE VERTICAL MILLER

AeroED 1887 (Sept. 1943) . . .

Improved vertical bench milling machine with a quick change attachment for horizontal milling.

A 2½-in diameter arm supporting the spindle head is clamped rigidly to the column and can be readily adjusted to rotate



the spindle 60° either side of center. Or, the entire head is easily removable, to be replaced with an enclosed horizontal milling attachment. Thus, a variety of jobs such as precision die making, profiling, or key slotting can be easily handled. Compactly designed to do a big job in a small space, this two-way machine stands 30-in high, has a precision ground table 6 by 14 in, with three T slots ⅜-in, 2-in centers.

Micrometer adjustments for the table movements are operated by convenient splined disengageable hand cranks, while graduated dials reading in thousandths of an inch make resetting a simple process. A streamlined enclosed spindle offers safety and improves appearance. A sturdy sub-base adds rigidity to the machine and improves working height for convenience of operation. Proper tension on the V-belt is assured by a floating motor mount and rapid changes of the four spindle speeds (450, 850, 1400, and 2100 rpm) are thus possible without the use of tools. The spindle has a No. 2 Morse taper. The milling machine is powered with a ⅓ hp motor.

This relatively small machine will do many types of work for which it used to be necessary to tie up a large tool.

Benchmaster Tool Co., 2952 West Pico Blvd., Los Angeles, Calif.

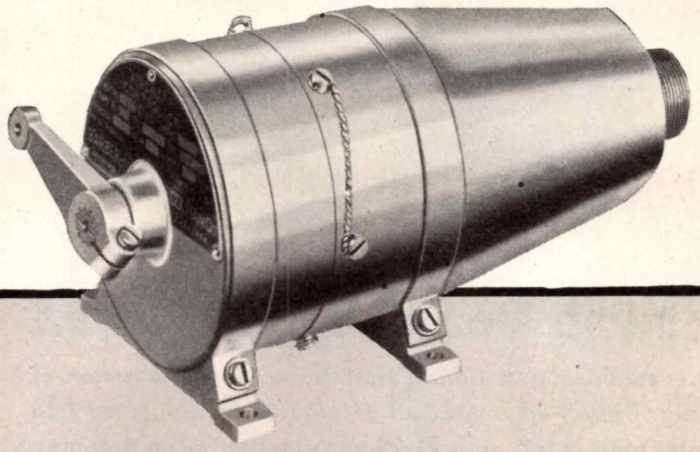
CEMENTED-CARBIDE BURRING TOOLS

AeroED 1888 (Sept. 1943) . . .

The first line of cemented carbide burring tools (rotary files).

The tools, to be known as Carburs, have cutting teeth which are ground from the solid on special machines and the cemented-carbide heads are securely attached to the shanks. It is claimed that Carburs will provide many times the tool life of high speed

(*Continued on page* 307)



BARBER-COLMAN CONTROL MOTORS

THERE are lots of places on an airplane where you want to set a flap, or change a valve, or move a lever or rod, or pull a cable, or drive a gear — preferably by remote control, and sometimes automatically. To perform these functions reliably and accurately, we offer our line of Control Motors and our experience in designing them to meet stated requirements. We can furnish motors from approximately 30° travel up to 10 revolutions between limits. Most any combination of gear reduction can be arranged, depending on whether a high speed or low speed unit is needed. The fastest we have so far produced gives a final speed of about 15 r. p. m. The output shaft can be arranged for gear or lever drive and for end or side location. Recently we have been delivering quite a number with magnetic brakes to prevent over-travel. These Control Motors are suitable for operation in temperatures from −65°F. to +160°F., for altitudes up to 40,000 feet, and are available with torques up to 500 pound-inches. If this suggests a use in your own work, drop us a line and let's talk it over.

BARBER-COLMAN COMPANY, ROCKFORD, ILLINOIS

TO *SPEED* PRODUCTION HERE'S *DOUBLE BARRELED ACTION!*

WETMORE *DESIGN FEATURES*

No other reamers and boring bars have the combination of production-speed-up engineering features incorporated into Wetmore tools, such as: Rigid construction with patented blade lock and extra heavy blades, insures better finish without digging in or chatter . . . threads milled on centers, blade seats ground true with threads, and blades always bottomed, permits holding to close tolerances . . . blades may be set out 7 to 50 times, depending on size . . . and heavier cuts may be taken because of rugged construction, scientific grinding and quality materials. Wetmore tools have been known for years among top-flight metal working plants as the quality line, and Wetmore users represent practically a "blue-book" of American industry.

STOCK DELIVERY Tool up now for higher war production, and be ready also for the post-war accumulated demand for consumer and other goods. Phone, wire or write.

WIRE OR PHONE us for quotations and delivery dates, and for the Wetmore Tool Catalog if you don't already have it.

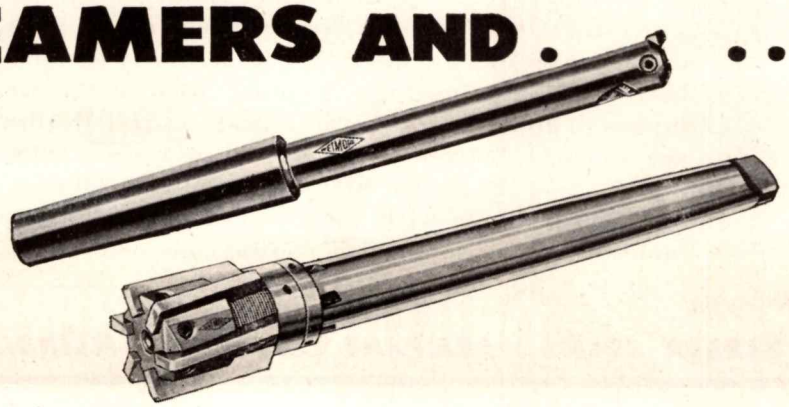
WE'VE STEPPED UP REAMER PRODUCTION

With new, single purpose high production machines installed in our plant, new expediting methods, and new planning schedules, we have been able to step up the manufacture of Wetmore Reamers and Boring Bars to the point where we can make stock delivery of standard types and sizes, and unusually good delivery on other items.

SO YOU CAN SPEED UP WAR PRODUCTION

The faster cutting and finer finishes you get on precision holes with Wetmore quality tools mean less machine time per piece . . . less manhours per piece . . . less spoilage . . . longer life of tools . . . less tool setting and maintenance . . . all of which add up to higher production and lower manufacturing costs.

REAMERS AND . . BORING BARS

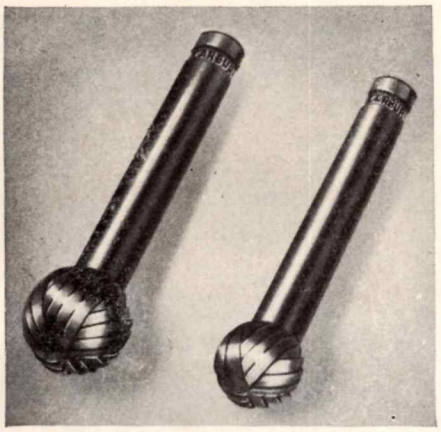


WETMORE REAMER COMPANY

418 N. 27th St., Dept. H, Milwaukee, Wisconsin

(*Continued from page* 305)

steel burring tools. Providing a sharp cutting edge over a long period of time, these tools reduce burring time per part and generally increase the efficiency of burring operations.



It is also claimed that because of high wear-resistance, less replacement is necessary, inventories of burring tubes can be reduced and tool sharpening is reduced in proportion to the life of the tool. Carburs can be run at higher speeds than have been possible with steel tools—another factor in reduction of finishing time. At the present time, these heads are supplied only in ball end types in ⅜- and ½-in sizes. These dimensions refer to the diameter of the carbide ball ends. The shanks are .250 in diameter and the burring tools are 2½-in over-all.

•

The photograph shows the workmanlike character of the tools. A report from an aircraft engine manufacturer states that these tools lasted a hundred times longer than steel burring tools in production work on cylinder heads and crankcases.

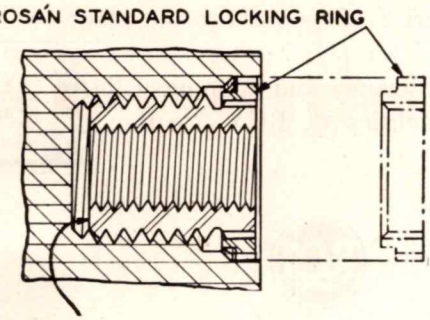
Carbur, Inc., Lincoln Park 25, Mich.

REPLACEABLE MOLDED-IN INSERTS AND STUDS

AeroED 1889 (Sept. 1943) . . .

New application of a locking system for threaded inserts and studs in metals, plastics, and other materials.

ROSAN STANDARD LOCKING RING



ROSAN STANDARD INSERT

This device, the "Rosan One-Piece Molded-In Insert," and also the Stud, is for plastics and other molded materials which require fastening points. Like the standard threaded insets and studs, it is locked in, but can be removed without injury to the material leaving a threaded, counterbored and serrated hole into which a standard threaded insert or stud may be screwed and locked by the regular process.

The principle of this locking system is simple and ingenious. On the insert or stud there is a serrated collar. The locking ring which is serrated both inside and out engages its inner teeth with the serrations on the collar, while its outer teeth or splines broach their way into the parent material at the sides of the counterbore. The pressure of the surrounding material causes the ring to close in upon the collar enough to eliminate all tolerance and make a solid installation which is permanent.

To remove the molded-in insert for replacement with a standard unit, the serrated locking head at the top of the insert is drilled until the drill passes into the thread relief. This leaves the outer portion of the head in the form of a serrated ring. An "easy out" tool inserted in the drill hole, backs out the threaded portion of the insert. The remainder of the ring may be lifted out by hand. The procedure for removing the molded-in stud is the same except a hollow mill is used for drilling out the serrated locking flange of the stud. The threads and serrations are left molded in the material so that the standard units may be installed without further operations. This system has a multitude of applications since it locks inserts and studs in any material which can be drilled and tapped.

(*Continued on page* 309)

On Schedule!

Pan American Clippers . . .

PHOTO COURTESY PAN AMERICAN WORLD AIRWAYS SYSTEM

Behind the rigid schedules for which Pan American Clippers are famous is an ever-active "ground crew"—skilled engineers and machinists charged with the responsibility of keeping the Clippers in shipshape condition for their long international jumps.

Buffalo Drills are dependable teammates of these maintenance experts at their Marine Base, La Guardia Field, New York. Here, in the engine shop, versatile Buffalo drilling equipment is employed on a wide variety of operations—performing with typical Buffalo accuracy, speed and ease of control . . . There's a Buffalo Drill designed *right* and built *right* for practically every metal drilling assignment. Details on the Buffalo line will be sent promptly on request.

ARMY E NAVY

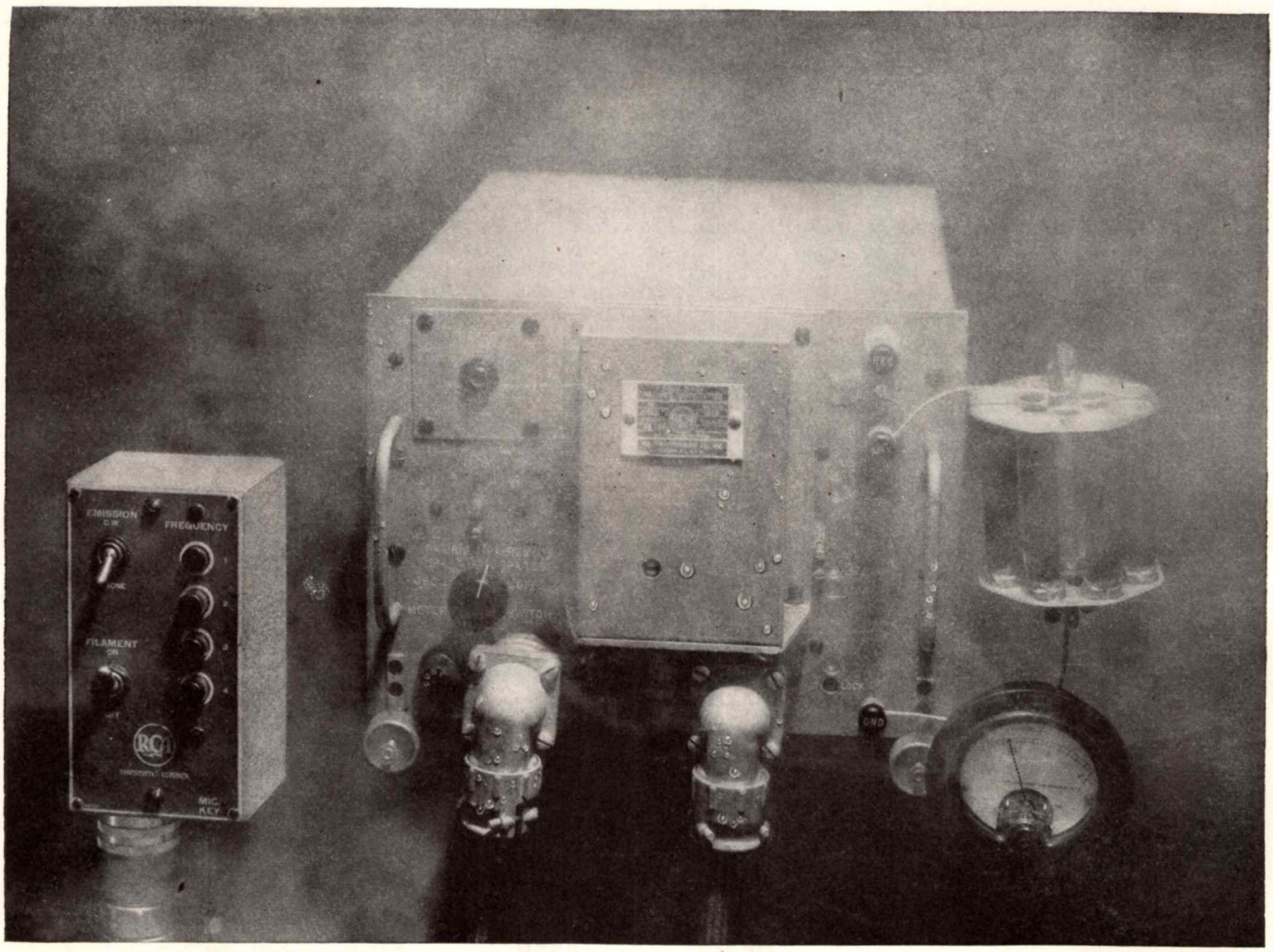
BUFFALO FORGE COMPANY

165 MORTIMER STREET BUFFALO, NEW YORK

Branch Engineering Offices in Principal Cities

CANADIAN BLOWER & FORGE COMPANY, LTD., KITCHENER, ONTARIO

"Buffalo" **DRILLING MACHINES**



READY FOR THE "GREEN HELL"

HEAT-LADEN moisture is a deadly enemy of electrical installations—and aircraft radio equipment is no exception.

Yet the radio apparatus of America's fighting planes and bombers *must* function perfectly in landing fields and dispersal areas hacked from the "green hell" of Pacific jungles.

The ability of RCA aircraft radio units to meet these conditions is proved by test—and confirmed in service.

The picture above shows such a test—an RCA laboratory "sweat-room" in which RCA aviation radio equipment is exposed to steam-saturated atmosphere at 60° C. (140° F.) and 95% humidity.

There the equipment is prepared for the ordeal of rain-drenched Guadalcanal or New Guinea.

Such procedures are typical of RCA radio engineering and manufacturing. At every step theory is supplemented by severe and exhaustive tests to make sure that *stamina* accompanies efficiency.

These characteristics, essential to war planes, will be equally valued for postwar transports. Then, as now, efficiency and stamina will be "built-in" qualities of RCA Aviation Radio.

RCA

RCA AVIATION RADIO

RCA VICTOR DIVISION • RADIO CORPORATION OF AMERICA • CAMDEN, N. J.

(*Continued from page* 307)

Previously a molded-in insert or stud could not be removed without injury to the parent material, and once removed, there was no way to replace it with any permanent installation. Hence a definite advance has been made. An engineering design data sheet is available which illustrates the process described very clearly.

Bardwell and McAlister, Inc.,
7636 Santa Monica Blvd., Hollywood, Calif.

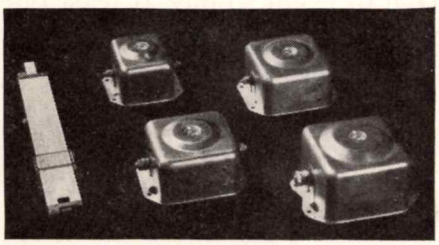
RADIO-NOISE FILTERS

AeroED 1890 (Sept. 1943) . . .

New line of aircraft radio-noise filters.

The filters are used on aircraft electric systems, circuits with such equipment as generators, amplidynes, inverters, and dynamometers. Their high attenuation characteristic results in excellent noise suppression, especially in the range from 200 to 20,000 kilocycles.

The filters are compact and lightweight. For example, in the 100-ampere rating, the unit weighs approximately 2⅕ lb, and measures 5 by 4 by 2½ inches. They can be mounted in any position, and will operate over a temperature range of ±50 C. They are available in ratings of 20, 50, 100, and



200 amperes, d-c, at 50 volts. The new filters comply with U. S. Army Air Forces specifications, including the requirements for vibration and acceleration.

•

In combat work high fidelity reception is absolutely indispensable, and these filters, with their wide range, can give full protection against any equipment likely to be carried on the airplane.

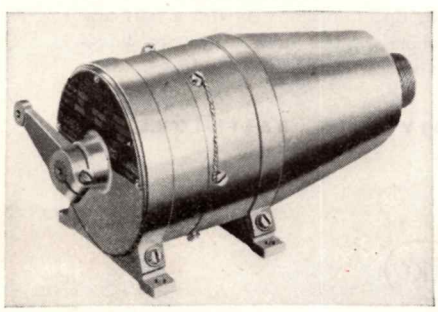
General Electric Co., Schenectady, N. Y.

CONTROL MOTORS

AeroED 1891 (Sept. 1943) . . .

New aircraft control motors for low temperature, high altitude accessory operation.

The new motors are used for the control of dampers, for governing cabin temperatures, controlling flow of air through supercharging, intercooling equipment and engine cowl flaps. They are also used to drive valve mechanisms on lines carrying gasoline, water, steam, anti-freeze mixtures etc. and for the operation of gasoline dump valves and cabin pressure regulating valves.



The motors are housed in aluminum cases; all gears are machine-cut, hardened and packed with a low temperature lubricant. Totally enclosed tamper-proof limit switches are set for 90° or 180° rotation. Control motors may be obtained with or without mounting brackets with AN-type connector plug mounted on end, and are available for positive, floating, or proportioning control, or for step control by manual or automatic means for remote position indication. The new motor weighs approximately 5 lbs and torque is 50 to 500 lbs/in.

The motors are remarkably well adapted for any task in actuating or controlling or indicating that can occur on board the modern airplane, and are of neat and compact design.

Barber-Colman Co., Rockford, Ill.

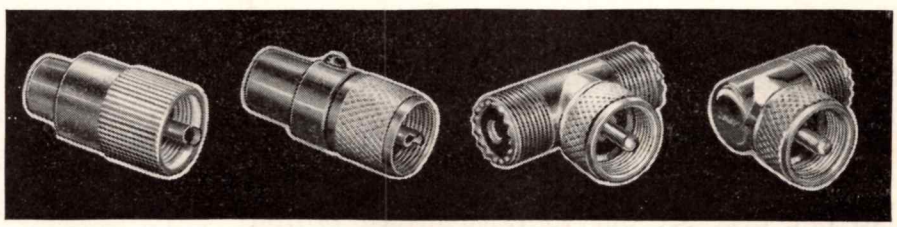
POWER RELAY

AeroED 1892 (Sept. 1943) . . .

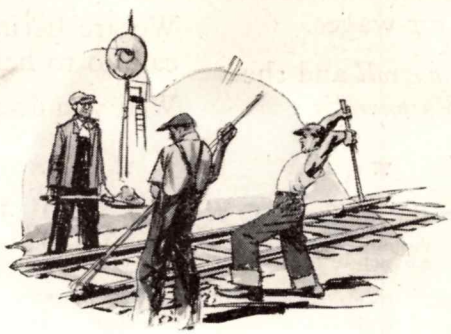
Small relay designed to meet aircraft requirements in operation on low d-c voltage.

The relay is designed particularly for aircraft power circuits. It will perform at high values of acceleration of gravity and also under conditions of vibration and shock. The

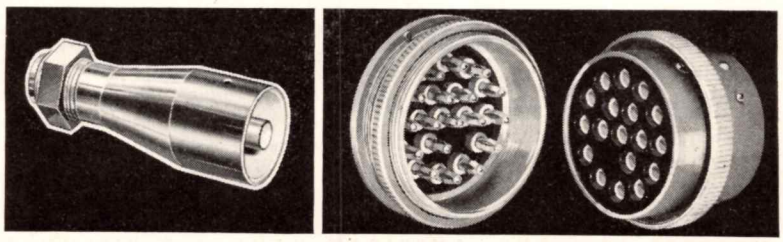
(*Continued on page* 311)



Building Railroad Tracks for ELECTRONS



BEFORE being shot out into space to perform their amazing tasks, radio's tiny electrons must travel tortuous circuit paths or tracks laid down for them when radio equipment installations are made. These "tracks," or cables, are held together at intersections, curves and terminals by what is known, in the language of electronics, as Constant Impedance High Frequency Connectors, Coaxial Cable Connectors, Multi-contact Plugs and Sockets and other similar parts familiar to the industry. Astatic's manufacturing facilities are today devoted chiefly to the volume production of these important parts. Approved by Army and Navy engineers, and highly praised by many leading electronic equipment manufacturers, Astatic Connectors are rendering the highest degree of operating efficiency in wartime service.



ASTATIC

IN CANADA:
CANADIAN ASTATIC, LTD.
TORONTO, ONTARIO

THE ASTATIC CORPORATION
YOUNGSTOWN, OHIO

Can you get

each of your employes to

BUY AN EXTRA $100 BOND

in September?

That's the problem.

That's the job of the Third War Loan.

The objective is to raise fifteen billion dollars. No one ever set out to raise fifteen billion dollars at one time before in all the history of the world. To raise that kind of money, you have to go where the money is . . . the idle money.

72% of all the *idle* money is estimated to be in the hands of people who work for wages.

They are the employes on your *payroll* and the employes on other business men's *payrolls*.

You are the quickest, most direct route to those millions of men and women.

You know them.

You have access to them.

They are *your* particular *prospects*.

If you can get each of them to buy at least one extra $100 war bond (price: $75), in addition to their regular payroll deduction purchases, the Third War Loan will be a success.

We are listing below some of the things you can do to help sell an extra bond to each one.

Will you do them?

HERE'S HOW TO DO IT!

This brief outline was prepared expressly for your use by a nationally-known firm which recently directed a successful war bond selling drive among a large group of Koppers employes.

You have undoubtedly served on some money-raising campaign in your city . . . for your favorite hospital, or community fund, or Red Cross.

You know how those campaigns are organized.

Organize one in your own plant or plants for the Third War Loan.

1. Appoint a campaign committee, or have the labor-management committee appoint one.

2. Head it up with a chairman who is aggressive and a go-getter.

3. Have committees set up for each shop or each department. Organize them as teams, to compete with each other. Americans love competition . . . we love to make a game of our work. Appoint leaders for all committees and give them military titles.

4. Appoint a campaign manager who can devote full time to the campaign until you reach your goal.

5. Start with a big rally. Get your local Army or Navy office to send officers and men to take part in the rally, or have a returned war hero appear, for morale purposes. If you are working on war work make some special shipment as part of that rally.

6. Put up exhibits and posters around the plant which you can get from your local War Loan headquarters.

7. Have a bulletin board on which you can post daily the *percentage* of employes who have signed up in each department or on each team.

8. Have some newspaper publicity about what you are doing. It will encourage your people and will help the company, too. Tell the publicity director of your local War Bond campaign what you are doing.

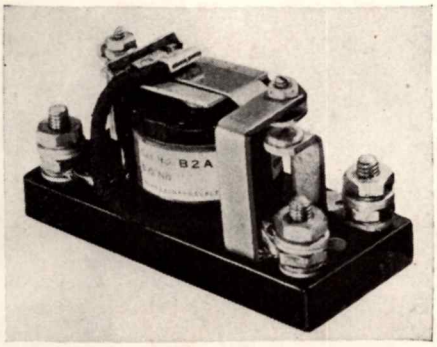
9. Where employes are unable to afford a $75 expenditure for a $100 war bond, encourage them and members of their families to sell war stamps to their friends and neighbors and credit these sales against the team total.

10. End the campaign with a rally and honors or prizes for the biggest producers or hardest workers.

KOPPERS COMPANY, AMERICAN HAMMERED PISTON RING DIVISION, BALTIMORE, MD.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY



(*Continued from page* 309)

armature and contact assembly are designed to retain either position under these conditions. The normally-open, single pole contacts are rated 25 amp at 24 v d-c non-inductive load, with good characteristics on inductive loads. The contact gap and tail spring tension are adjustable. Molded Bakelite nearly ⅜-in thick forms the base measuring 1⅜ by 3⅛ inches. Two holes are provided in the base for mounting.

•

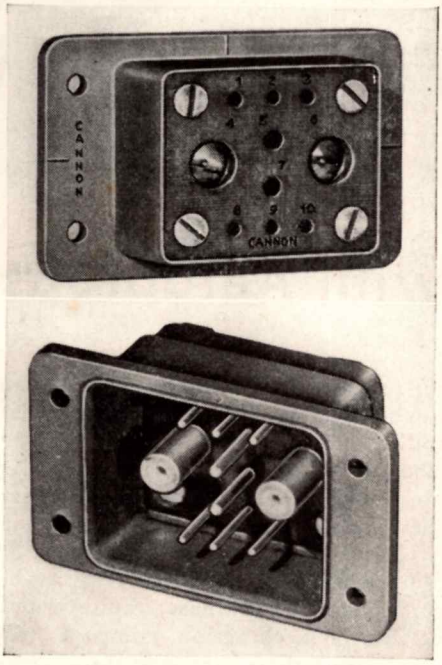
Acceleration tests have exceeded 10 g and the relay has successfully encountered vibrations of 60 cycles and 1/32 inch amplitude.

Ward Leonard Electric Co., Mount Vernon, N. Y.

RECTANGULAR ELECTRICAL CONNECTOR

AeroED 1893 (Sept. 1943) . . .

Rack type connector adapted by its design to radio rack assemblies, transmitters and any general applications where both plug



and receptacle must be fixed permanently in their respective units of equipment.

The DP-B connector is rectangular and is so designed to fit rack equipment. The shell is tapered to effect a close fit when engaged, and the two units of the complete connector are self aligning but are dependent upon the accuracy of the equipment it connects. The insert insulation is made of molded phenolic, having 8 standard contacts of brass, silver-plated, and two coaxial contacts of the same material and finish, with isolantite insulators.

Two contacts are 30 amp and 6 are 15 amp. The shell is die-cast aluminum alloy, with sand blast and clear lacquer finish. There are four mounting holes of .144 in diameter countersunk for No. 8 flat head machine screws. The receptacle weighs .276 lb and the plug .266 lb.

•

Plug and receptacle form a neat and compact unit.

Cannon Electric Development Co., 3209 Humboldt St., Los Angeles, Calif.

WET CUTTING METAL SAW

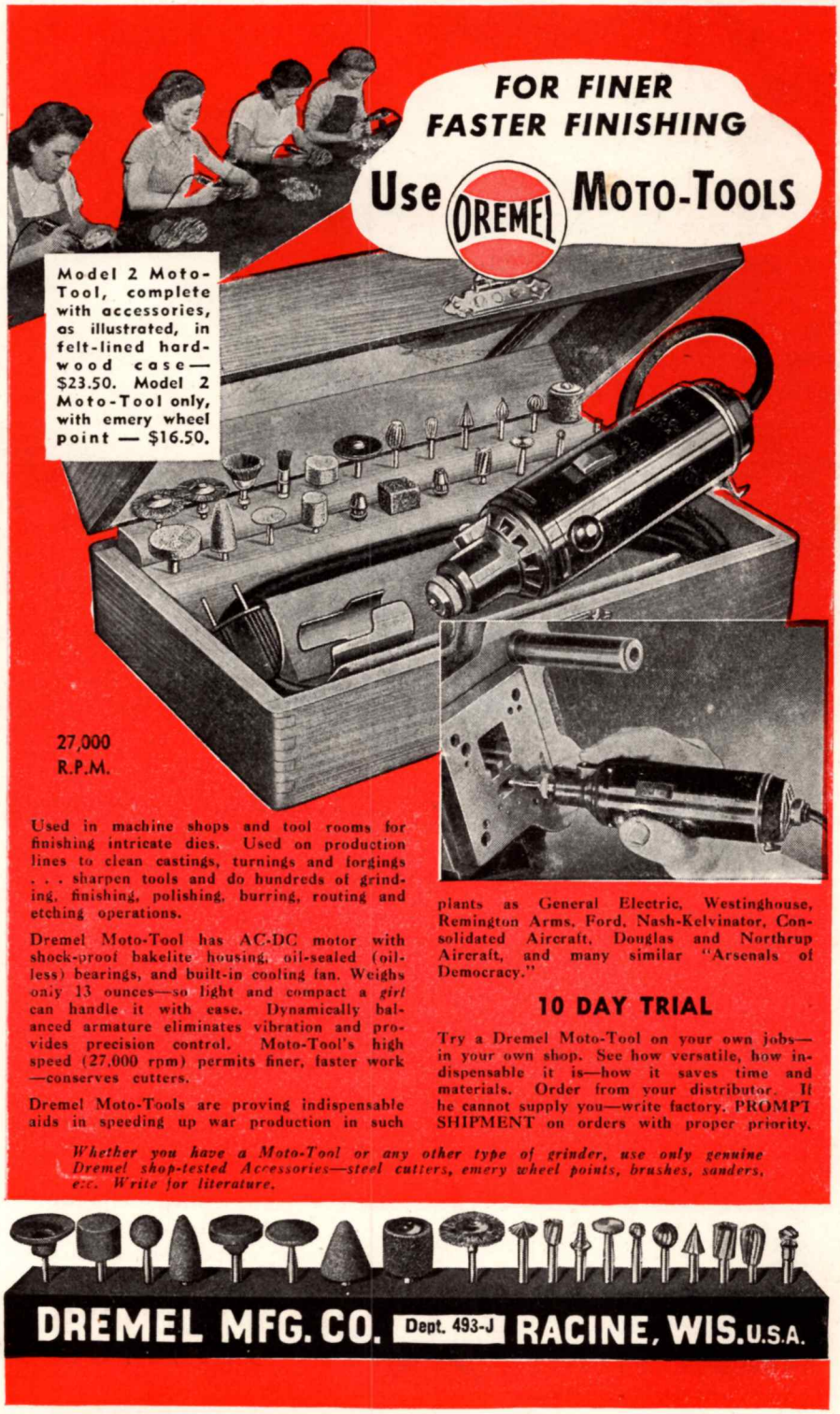
AeroED 1894 (Sept. 1943) . . .

New metal saw (with interesting features) for high-speed work.

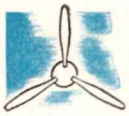
Its pump is of the non-clogging piston-type, driven by a noiseless cam and mounted in a frame without impairing overall streamlining of the machine. No additional power source is required as it is taken from the usual drive gear, so that the necessity of a separate motor is eliminated. The power take-off also avoids special wiring and extra switches.

The speed of the pump is automatically regulated by the speed of the machine and

(*Continued on page* 313)

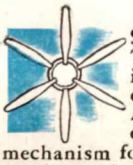


It's easier to *KEEP 'EM FLYING* with Aeroprops



LIGHT—Weight is at a minimum in the Aeroprop, with its ribbed steel blades.

STRONG—Propellers on combat planes take a terrific beating. The Aeroprop is engineered to "Keep'Em Flying."



SIMPLIFIED—The Aeroprop is built as a self-contained unit. Automatic pitch control and power mechanism for pitch changes are integral parts of the compact propeller assembly.

BUY WAR BONDS—
KEEP AMERICA FREE

GROUND crews praise the simplicity of Aeroproducts propellers. It's their job to service ships in "nothing flat" and get them back into action. The Aeroprop simplifies that job.

True, the Aeroprop has every advanced feature of propeller operation, including many exclusive principles of its own, but these are combined with such simplicity that servicing-time is cut to a minimum. The simple working mechanism is contained in the compact propeller assembly itself—easily accessible for quick inspection, replacement or repair. If necessary, the entire propeller can be "pulled" without dismantling other sections of the engine or of the plane. In brief, the Aeroprop is designed for swift servicing, for economy of time that means savings in peace-time as well as in war.

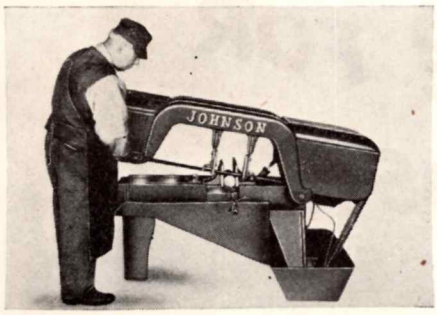
Simplicity is just *one* Aeroprop advantage. Strength, lightness, rapidity and precision of pitch action, compact unit-construction—these are additional features that have qualified the Aeroprop for service on thousands of America's war-planes.

AEROPROP

AEROPRODUCTS DIVISION **GENERAL MOTORS** CORPORATION

GM ARMS FOR VICTORY

(*Continued from page* 311)
flow of the coolant is in direct relation to blade speed. The pump automatically stops and starts with the machine and steady flow



of the coolant is insured through the use of a ram which smooths the pump impulse. If dry cutting is desired, the pump can be readily disconnected. The new saw may be easily equipped with this coolant feature and installation can be made in approximately 45 min.

•

The system is evidently the result of careful design and is proving eminently satisfactory.

Johnson Mfg. Corp., Albion, Mich.

MINIATURE SCREWS

AeroED 1895 (Sept. 1943) . . .
Miniature screws are used in the building of precision instruments.

The new screws are of .072-in diameter, precision made and so nearly perfect that they may be magnified many times without disclosing a single flaw in heads, threads or points.

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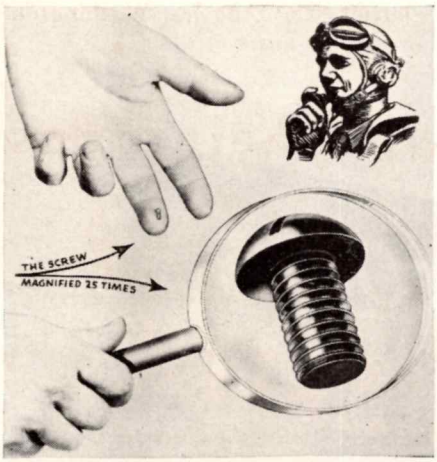
The tiny fasteners are made to AN specifications and are employed in aviation head-



phones, microphones and similar delicate aviation accessories.

**Manufacturers Screw Products,
216 W. Hubbard St., Chicago, Ill.**

TUBE HANDLING MACHINE

AeroED 1896 (Sept. 1943) . . .
New machine squares, burrs, flares and beads ferrous and non-ferrous tubing.

The new machine reduces the percentage of rejections of coined, thinned or imperfectly machined tubing, reduces the need for hand tools and dies and produces work of uniform and consistent accuracy in all operations. Ten sets of flaring dies and centers, squaring and burring attachments are standard equipment of the unit for tubing ¼-in O.D. to 1½ in O.D.

•

Work produced by the Tube Master as it is called has met stringent Army-Navy specifications, and many aircraft factories have adopted it as standard equipment. Set-up time is short, and compact design permits installation even where bench space is at a premium.

**Leonard Precision Products Co.,
1100 Larson Ave., Garden Grove, Calif.**

PLASTIC INSULATION

AeroED 1897 (Sept. 1943) . . .
New plastic insulation material, made from resin, closely resembling packed snow.

"Plastic Foam," as it is called, is a wartime replacement for Airfoam, sponge rubber derived from spun latex and widely used while rubber was available as an insulating material and wing-filler on military airplanes. The foam is now being turned out in limited quantities for insulating U. S. Army Air Corps airplane cabins against heat and cold.

It is highly resistant to the transfer of heat, non-inflammable, waterproof and resilient. In addition, it is highly soundproof. At present, the new product is being made in two types, a plain type and an impreg-

(*Continued on page* 315)

The Women's Army Corps has valiantly taken over many non-combatant duties, releasing men for front-line fighting. In airports and message centers the WACs perform well many of the arduous tasks involved in receiving and transmitting communications within the vast scope of the U. S. Army Signal Corps.

CONSOLIDATED RADIO PRODUCTS COMPANY takes just pride in the fact that its headphones are used by the Signal Corps on all the battlefronts of the world. Engineered for complete dependability, CONSOLIDATED RADIO products are withstanding the severest demands of service with the Tank Corps and the Infantry, as well as the Air Corps.

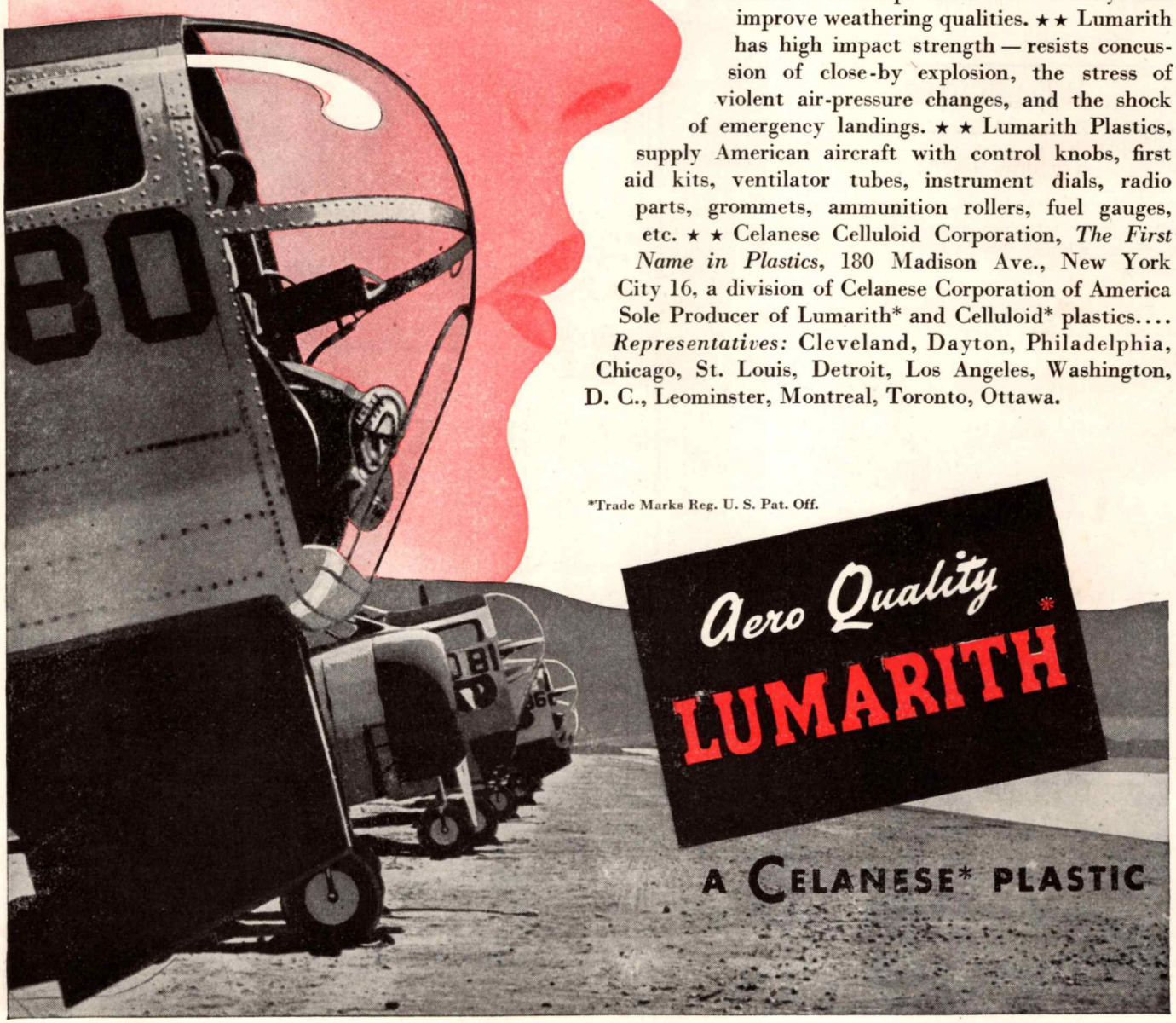
Consolidated Radio's Modern Mass Production Methods Can Supply Signal Corps and Other Headphone Units in Quantities to Contractors.

Electronic and Magnetic Devices
CONSOLIDATED RADIO
Products Company
350 W. ERIE ST., CHICAGO 10, ILL.

THERE IS A PLACE FOR A SHINY NOSE

Calamity for the Axis is incubated in the "nose" of these Beechcraft Training Planes. Through the clear transparency of their plastic walls, the student bombardiers and gunners develop their shooting eyes and accurate aim. ★ ★ More transparent than glass, Aero-Quality Lumarith transmits light up to 92%, yet is stabilized to intercept the ultra-violet rays and improve weathering qualities. ★ ★ Lumarith has high impact strength — resists concussion of close-by explosion, the stress of violent air-pressure changes, and the shock of emergency landings. ★ ★ Lumarith Plastics, supply American aircraft with control knobs, first aid kits, ventilator tubes, instrument dials, radio parts, grommets, ammunition rollers, fuel gauges, etc. ★ ★ Celanese Celluloid Corporation, *The First Name in Plastics*, 180 Madison Ave., New York City 16, a division of Celanese Corporation of America Sole Producer of Lumarith* and Celluloid* plastics.... *Representatives:* Cleveland, Dayton, Philadelphia, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.

*Trade Marks Reg. U. S. Pat. Off.



(*Continued from page* 313)

nated type. Reinforced with cheese cloth or other fabric, the plain type is sufficiently strong to be handled freely but is somewhat susceptible to shock. The impregnated material's resilience is increased and its fragility decreased by adding a flexible substance.

•

The new material is even claimed to be superior in some respects to the sponge rubber which it replaces and to be lighter than balsa or airfoam.

Goodyear Tire and Rubber Co., Akron, Ohio

28-VOLT AIRPORT RECTIFIERS

AeroED 1898 (Sept. 1943) . . .

New flat compounded rectifiers hold 28 v practically on the line, with any load from zero up to 350 amp, and voltage may be increased for fast charging.

The new units operate from 3 phase power lines, with convenient connectors for this purpose, and are available in both portable and stationary models.

•

No storage battery or motor generator has this regulation valve, so that this constitutes a decided advantage while testing or starting electric motors. The unit was originally developed at the request of one of our leading airplane manufacturers.

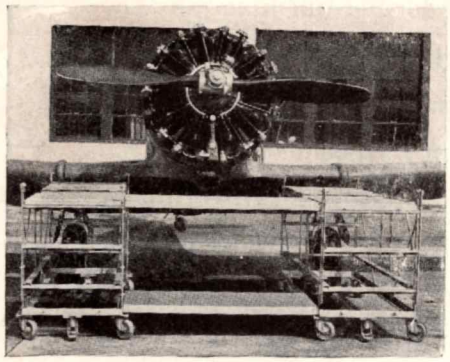
Electron Equipment Corp., Palm Springs, Calif.

FOLDING SERVICE STAND

AeroED 1899 (Sept. 1943) . . .

Multi-purpose work and repair platform adjustable to the heights required for jobs on engines, wings, fuselage, or tail assembly.

Without the use of a single tool two men can erect such a repair stand in a few minutes and positive truck locks hold it rigid when in use. Ladders at either end of the stand provide ready access to the platform whose working heights of 3½, 4½, 5½, or 6½ feet permit servicing of all kinds of land based planes, whether low, mid, or high wing type. A well provides adequate space for turning over the propeller without removing the stand. When a job is over, a slight push will send the platform rolling to the next operation on spark-proof plastic



casters. One stand provides a rigid working surface for one or more mechanics while for a continuous working surface two master units may be connected. When folded the stand slides easily under wings and occupies

(*Continued on page* 317)

ARMY TWILL BY REEVES SANFORIZED* MADE TO GOVERNMENT SPECIFICATIONS REG. U.S. PAT. OFF.

REEVES Glengarrie POPLIN

For Better Uniforms Demand These Labels!

REEVES ARMY TWILL SCORES A HIT!

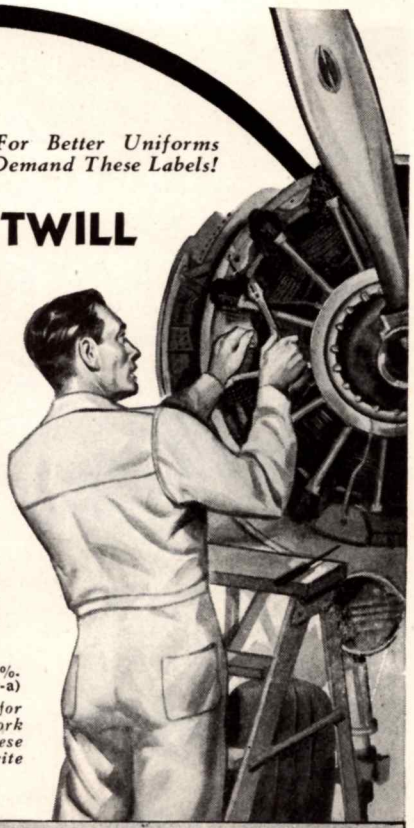
With pilots, ground crew and passengers alike, uniforms of Reeves Army Twill are way ahead in popularity. They're neat in appearance—long on wearing qualities! So specify this famous fabric when ordering *your* uniforms.

Reeves Army Twill passes U. S. Govt. tests for strength, endurance and color-fastness. For fabric vitality it's a leader!

For matching shirts, GLENGARRIE POPLIN is equally popular. Both fabrics available in favorite colors — are Sanforized* against shrinking.

*Fabric shrinkage not more than 1%. (U. S. Government Test CCC-T-191-a)

See your nearest dealer for uniforms, sport and work clothes made from these famous fabrics, or write for leaflet to:



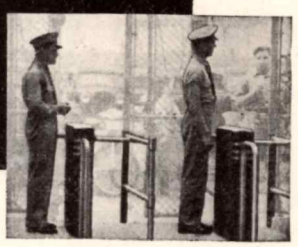
63 OVER ~~60~~ million yards of Reeves Army Twill sold to the U.S. Army

REEVES BROTHERS, INC.

54 WORTH STREET NEW YORK CITY

GATE GUARDS ARE HUMAN

DOUBLE THEIR EFFICIENCY WITH PEREY TURNSTILES



Gate Guards are subject to fatigue, uneven efficiency and sometimes negligence—they're only human. But—when reinforced with Perey Automatic Turnstile Systems their efficiency is doubled. They can devote full attention to inspection—at entrance against saboteurs—at exit to prevent the unauthorized removal from the plant of expensive, and sometimes irreplaceable tools, precision instruments and records.

CONTROLLED SPEED permits the easy flow of employees through the turnstiles as fast as they can walk—or stops instantly on emergency. The guard's authority is backed up by this subtle combination of psychological and physical influences compelling better behavior.

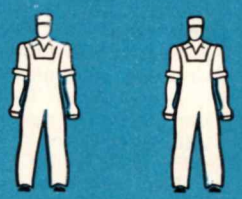
War Plant Gate Protection involves technical problems that must be solved correctly. Perey Engineers will help you design a system that will best fulfill your desired function. *Write for booklet.*

PEREY SYSTEMS ARE STANDARD EQUIPMENT IN

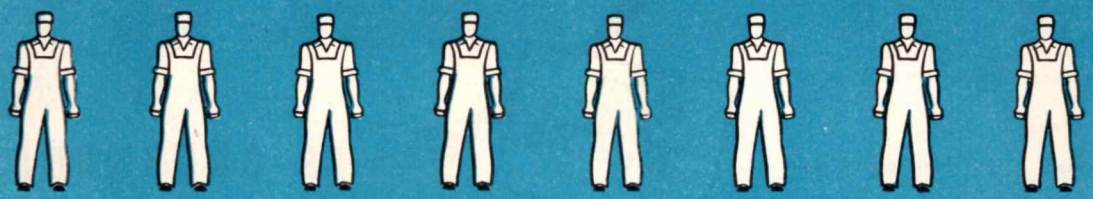
Aircraft Plants
Navy Yards
Shipyards
Arsenals & War Plants

PEREY TURNSTILE CO. *War Plant Division* Architect's Bldg., 40th St., New York

The *Alrok Finish* for aluminum may relieve production bottlenecks



TWO MEN OR EIGHT



Alcoa-research developed the Alrok* finish for use on aluminum surfaces that are to be painted. It has proved completely adequate for many parts. It is quite possible that this chemically-applied finish can be satisfactorily substituted in many places where the more expensive, time-consuming electrolytic finishes are now specified.

Note the savings possible where the Alrok finish is employed: In one plant, two men finish 800 pounds of small parts per hour by the Alrok process, and 100% inspection is not necessary. It takes eight men to finish the same quantity of parts by the electrolytic process.

Bear in mind that, for the use made of these parts, both jobs are equally acceptable. Only one fourth the number of men, and no electrical generators, are required for the former finishing job. The Alrok finish certainly deserves consideration for many parts on which the electrolytic finish is now specified.

There's an approved Government specification covering the Alrok finish for certain purposes. ALUMINUM COMPANY OF AMERICA, 2194 Gulf Bldg., Pittsburgh, Pa.

*Patented process

ALCOA ALUMINUM

(*Continued from page* 315)
little hangar space. Being a self-contained package (1 ft 5 in by 2 ft 10 in by 7 ft), the repair stand can be shipped without boxing.

•

Two such "Airefair" units connected together will give a continuous working surface 2½ ft wide and 22 ft long, and with the stand set at a convenient-height will permit six mechanics at one time to have access to de-icer boots on a wing. It can be readily seen what advantages this gives in maintenance work. Because the caster's swivel, it is positively easy to steer the stand into position.

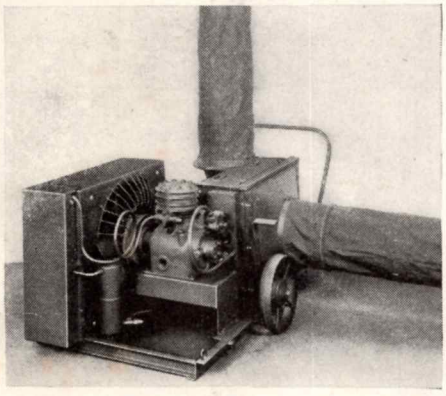
Wolfe & Mann Mfg. Co.,
Aircraft Equipment Div., Baltimore, Md.

MOBILE COOLER AND DEHUMIDIFIER

AeroED 1900 (Sept. 1943) . . .
Mobile cooler for reducing temperature and humidity to conserve time and manpower in essential war tasks.

This 600-lb., self-contained cooler and dehumidfier can be wheeled by one person. It has retractable wheels and a sled-like bottom with rings attached for towing through sand or over soft ground and the minimum of copper and rubber is used in its construction. The condenser and the evaporator utilize steel tubes and fins and the refrigerant is also made of steel.

The mobile cooler wheeled up beside planes, trucks, buildings, or field hospitals, can deliver cooled air through canvas ducts thereby permitting mechanics, technicians, doctors, and nurses to work faster and more comfortably. The unit, combining cooling with dehumidifying, filtering, and circulation of air, is helpful in the repair, adjustment and calibration of delicate instruments —bombsights, radio equipment, etc.—because high temperatures induce perspiration whose acid content corrodes steel and even nonferrous parts. High humidities rust steel parts, mildew other materials, and cause current leakages in electrical equipment, while dust can cause failure of electrical contacts, start undue wear, and ruin essential photographic prints.



•

The artist's sketch shows how handily the device can be used with the airplane itself, while the photograph gives an idea of the mobilty. As we never know where our armed forces may be operating, we can appreciate the fact that the wheels are retractable, and that the machine has a sled-like bottom with rings attached for towing through sand.

Carrier Corp., Syracuse, N. Y.

THREAD ROLL SNAP-GAGE

AeroED 1901 (Sept. 1943) . . .
Combined "Go" and "No Go" limit gage for checking male threads to both maximum and minimum limits in one operation.

The "Thread Roll Snap-Gage" consists of a frame similar to a plain snap gage in which two sets of gaging rolls are mounted, each roll being free to rotate. One set of rolls represents the "Go" limit, the other the "No Go" limit. This gage checks critical conditions in the thread, i.e., such as the pitch diameter, the thread angle and lead. The thread roll snap-gage gives faster inspection than the ring gage and is more economical due to one roll snap-gage taking the place of two ring gages and because the gage rolls rotate with a minimum of friction and can be reground repeatedly. The Sheffield Thread Roll Snap-Gage is furnished standard for American National form, coarse and fine series. Gages for all other forms are made to order.

•

In the case of a stud having both left and right hand thread, the Snap Gage replaces four ring gages, and because it checks all
(*Continued on page* 319)

Once upon a time there was a little "Jeep"—but the rest of that story needs no telling, for no one piece of war equipment has won undying fame so quickly, nor endeared itself to the hearts of all fighting men than has the "mighty midget" shown above. But—take another look—for just above it is another already famous Jeep, the Jeep with wings, the "skeeter-bug" of the air.

This miraculous new Army plane is the Sentinel, or "Flying Jeep," perfected and produced by Consolidated-Vultee's Stinson Division at Wayne, Michigan. This is the plane which has become as integral a part of the U. S. Field Artillery as the big guns which roll into position beneath it. It is the "eyes upstairs" of all Army Ground Forces. It is the "finger man" that is putting the Japanazi gangsters on the "spot."

Any manufacturer would be glad to play even a minor part in the contribution which planes such as the incredible Sentinel are making to Victory. That's why here at McAleer, working round-the-clock, we feel humbly proud to deliver in volume many of the surface assemblies which go into the "Flying Jeep." We feel privileged in being selected to add our efforts to America's tremendous plane producing program.

Tomorrow's world of flyers and plane builders will find McAleer air-minded in the fullest sense of the word.

Military aircraft assemblies alone are not all of the war products of the McAleer Company; there are others which extend into and virtually cover the fields of military pyrotechnics and hydraulics—yes, and embrace our complete industrial finishing facilities as well.

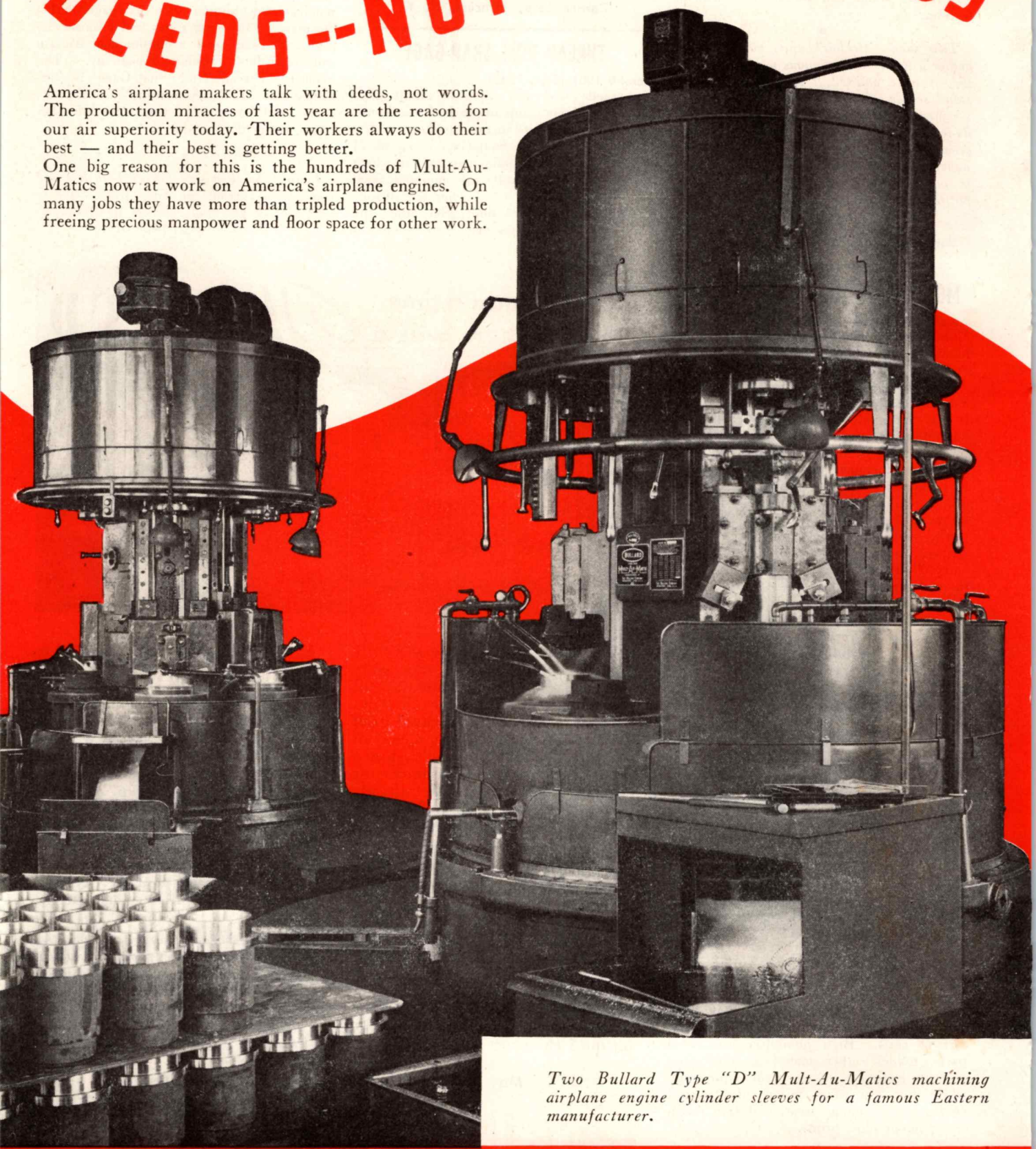
May We Put Our Shoulder to the Wheel You Are Turning on the Road to Victory?

McAleer MANUFACTURING CO.
Quality-Controlled Finishing Materials
ROCHESTER, MICHIGAN

DEEDS--NOT JUST WORDS

America's airplane makers talk with deeds, not words. The production miracles of last year are the reason for our air superiority today. Their workers always do their best — and their best is getting better.

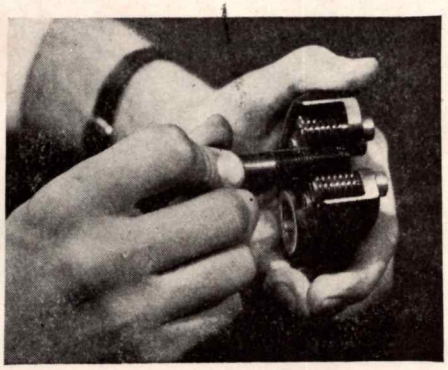
One big reason for this is the hundreds of Mult-Au-Matics now at work on America's airplane engines. On many jobs they have more than tripled production, while freeing precious manpower and floor space for other work.



Two Bullard Type "D" Mult-Au-Matics machining airplane engine cylinder sleeves for a famous Eastern manufacturer.

THE BULLARD COMPANY

BRIDGEPORT 2, CONNECTICUT



(Continued from page 317)

critical conditions, the Snap Gage goes beyond the conventional gaging possible with ring gages. It is now widely used in aircraft, ordnance and automobile work.

Sheffield Corp., Dayton, Ohio

PLASTICS FOR GROMMETS

AeroED 1902 (Sept. 1943) . . .

Grommets formerly made from rubber, now made from plastics.

The grommets displayed by the young lady in the photograph will release tons of rubber in the manufacture of planes, tanks, trucks, half tracks and other war equipment.

The strip shown contains 10 grommets of 4 different sizes and represents just one cycle of an injection molding press.

•

We understand that numerous other parts formerly made of rubber can be constructed with this plastic substitute.

Electric Auto-Lite Co., Bay Mfg. Div., Port Huron, Mich.

ALLOY SPRAYER

AeroED 1903 (Sept. 1943) . . .

New means of applying a protective metal coating to metal assemblies or structures.

The method recoats areas burned by welding, patches or repairs small areas in large galvanized assemblies where the coating has been damaged and in addition provides an ideal base for painting. An actual tinning of the base metal is effected. Thus, under certain conditions, sandblasting or other extensive preparation of the surface of the base metal is not necessary. The operation consists of spraying the surface to be protected with a coating of "Galv-Weld" metal, as the product is called, by means of an Alloy-Sprayer gun. The latter is a portable, self-contained "gun-type" unit, having a thermostatically controlled metal melting pot and a means of atomizing and spraying the melted metal. It is operated by air under pressure in much the same manner as a paint sprayer. A trigger control button is pressed lightly during the actual spraying.

A typical use of the equipment is for regalvanizing the areas from which galvanizing has been burned during arc or resistance welding operations. The oxide remaining from the welding operation is first thoroughly brushed off and the area adjacent to the weld is similarly cleaned. Then, while the metal is still hot, the entire burned surface can be sprayed. The thickness of the coating will be from .001 to .008 inches, depending upon the degree of resistance to corrosion required. The metal, an alloy high in lead and thus relatively non-critical, melts and is sprayed on at about 500° F. Speed of spraying will range upwards of 50 lineal fpm for a corner coating or bead coating. The use of the sprayer unit insures an even and uniform coating no matter how broken up by pits or pockets is the contour of the surface.

•

Some interesting photomicrographs made at 500 diameters of a coating sprayed on steel show that adhesion results even when the base metal is smooth. Another noteworthy point is that a sample of metal coated to a thickness of only 0.001 in stood a salt spray bath for 42 hours before any indication of rust spots began to appear.

Alloy-Sprayer Co., 2040 Book Bldg., Detroit, Mich.

WITH McKINNEY TOOLING

THE term "in jig time" always implies speed but here at McKinney's it has a dual meaning.

To assure great output of parts profitably, speed and facility of operation are built into every tool, jig and fixture. But these objectives are never attained at a sacrifice of extreme accuracy. Pride of craftmanship is paramount in every department even to uncommonly fine finishing of completed tools before shipping.

McKinney responded to the call for tremendously increased war production with decades of experience as machine designers, tool makers and manufacturers.

Today, the McKinney organization of several hundred engineers and tool makers is shipping tools, jigs and fixtures to both coasts, to Canada and as far south as Texas.

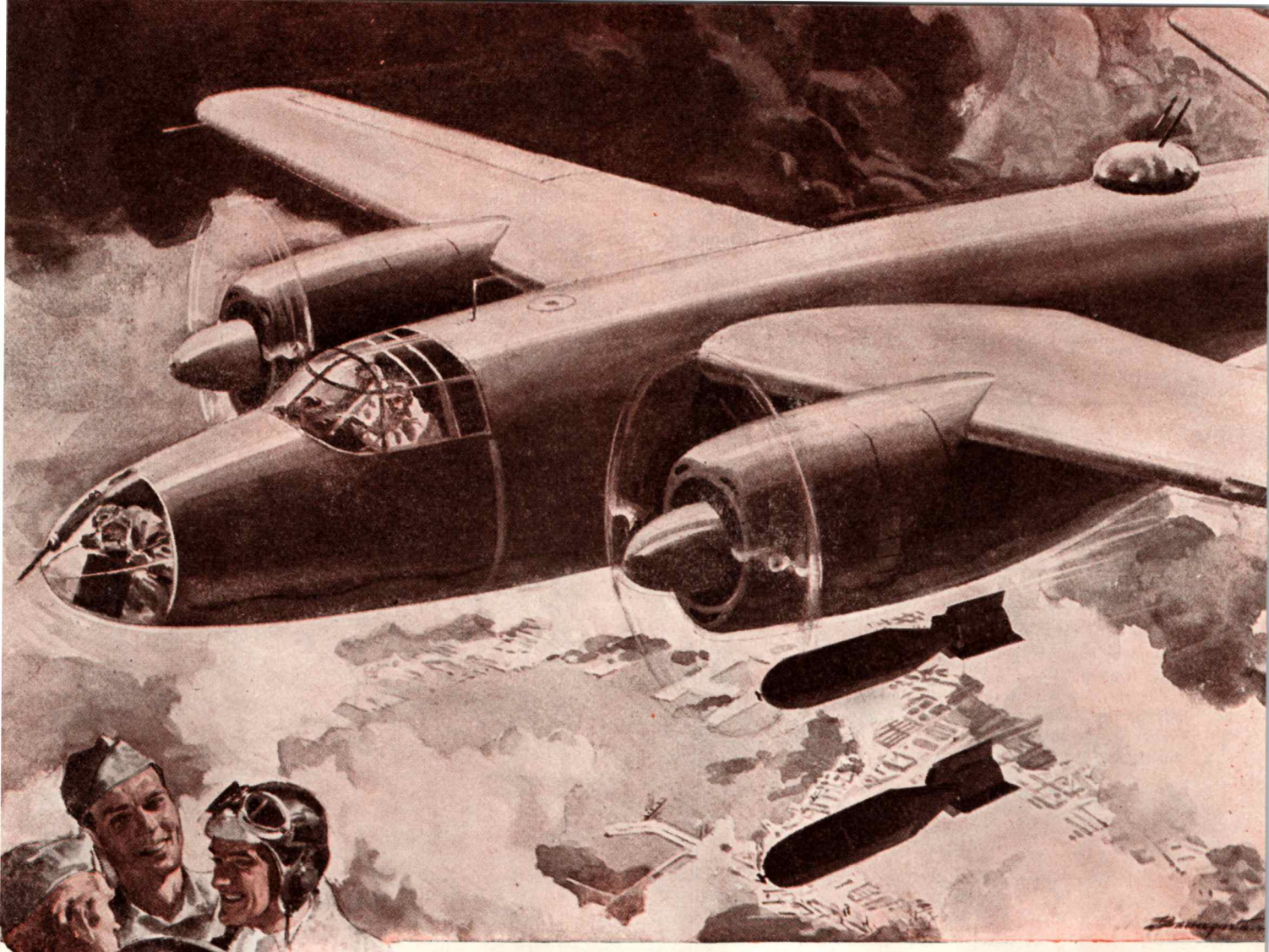
We'll gladly quote on building any tool already designed or have one of our engineers call to discuss problems of tool designing. Call upon us.

McKINNEY TOOL & MFG. CO. CLEVELAND

DESIGNERS and BUILDERS of PRECISION TOOLING Since 1920

1692 ARABELLA ROAD

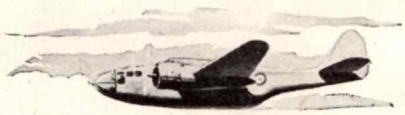
Tools·Dies·Jigs·Fixtures·Special Machinery



ARMY'S B-26 MARAUDER

THEY'RE WRITING HEADLINES
WITH A

MARTIN MARAUDER



BRITAIN'S BALTIMORE

ALEX . . . JOE . . . STEVE . . . ED . . . and BILL. You know them. Alex, who used to bring your groceries . . . Joe . . . Steve . . . Ed and Bill, who used to go with little Sally Miller. Likeable, quick-to-laugh young Americans. Give them the best aerial schooling in the world, put them in a rocket-fast, Martin B-26 Marauder, and they're a flyin', fightin' team that wins!

There's a reason for this, of course. Aircraft are highly complicated mechanical devices . . . and these boys were fitting together gadgets, tinkering with tools, racing old jalopies, when their adversaries were learning to "heil" and "banzai." They've got the feel of speed, the mechanical know-how that makes natural pilots, gunners and bombardiers.

This same technical skill gives America fighting planes like the Martin B-26 Marauder. Sleek, graceful, packed with speed, power and punch, it's the kind of plane that makes young America's eyes light up . . . makes him say, "Put me down for the Air Force!"

What's more, American technical skill is going to play a major role in fashioning the future. Already Martin has designed giant airliners of 125 or more tons . . . mighty ships that will bring distant nations to within hours of your doorstep. At the same time, our Army and Navy airmen, imbued with the thrill of flight, the love of speed, are resolving never to be shackled to earth again. They're in the air . . . to stay!

Alex... Joe... Steve... Ed... and Bill.
They're doing more than win a war. They're building a world that will take your breath away.

THE GLENN L. MARTIN CO., BALTIMORE
THE GLENN L. MARTIN-NEBRASKA COMPANY—OMAHA

NAVY'S MARTIN TRANSPORT

NAVY'S MARINER PATROL BOMBER

Martin
AIRCRAFT

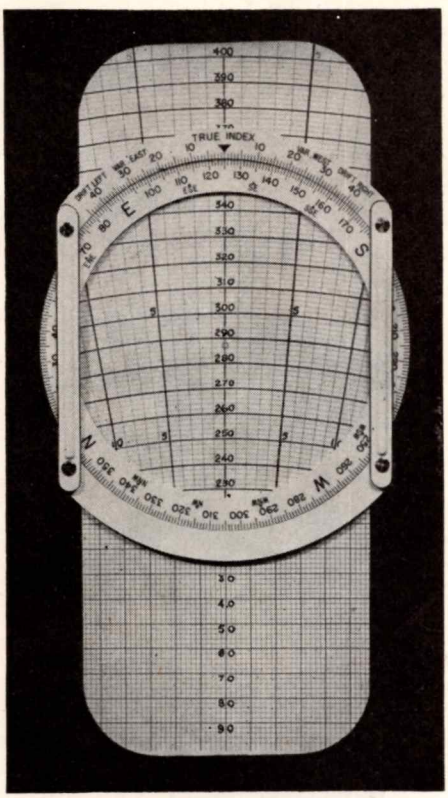
Builders of Dependable Aircraft Since 1909

A PLASTIC COMPUTER FOR AIR NAVIGATION

AeroED 1904 (Sept. 1943) . . .

The Dalton Computer, E-6-B, standard equipment for the Army and Navy Air Forces.

The slide rule side of the computer, shown in the illustration, readily solves the true altitude from the calibrated altitude, and vice versa; the true airspeed from the calibrated airspeed, and vice versa; and deals with multiplication, division, and proportion



problems, such as time-speed-distance; gas consumption; conversion of arc to time; interconversion of statute miles, nautical miles, and kilometers; and solution of the equations of radius of action. The vector side of the computer finds wind, groundspeed and heading, and track and airspeed.

•

The instrument is accurate, compact and can be worked rapidly. It is serviceable and can stand a lot of handling.

Weems System of Navigation, Annapolis, Md.

MACHINE FOR WEIGHING AND BALANCE-MILLING CONNECTING RODS

AeroED 1905 (Sept. 1943) . . .

New semi-automatic machine for weighing and balance-milling connecting rods for internal combustion engines.

For the purpose of this operation, a small amount of excess stock is left on each end of the forging and by milling into this metal, excess weight is accurately removed. The workpiece is first weighed and the amount of excess stock on each end determined by means of a double dial shadowgraph scale. The piece is then clamped in the fixture manually and by turning a hand wheel, the operator advances a finder which locates the excess metal on the connecting rod and immediately flashes on a green tell-tale light. This operation automatically brings the cutting tool into alignment with the tip of the finder.

An excess adjustment of as little as .002 in causes the red light to flash on and warns the operator to retract his adjustment until only the green light remains lighted. The operator then sets the pointer on the fan-shaped dial above the milling unit at the amount of excess stock which the scale indicated must be removed and this sets the cutter in position to remove that amount of stock. When these settings are made for each end of the connecting rod, an electric push button is pressed and both units feed cutters past the work, removing the excess stock and bringing the rod to correct balanced weight within the usual quarter-ounce limit. The machine is designed for handling one connecting rod and the distance between centers in the large and small pin holes is fixed. However, by providing suitable adjustors on the scale and fixture, two or more connecting rods of various lengths and weights can be balance milled on a machine of this type. No delicate dial indicators are used in locating the excess stock. The finder is ruggedly made of hardened tool steel, spring mounted and protected by an adequate housing.

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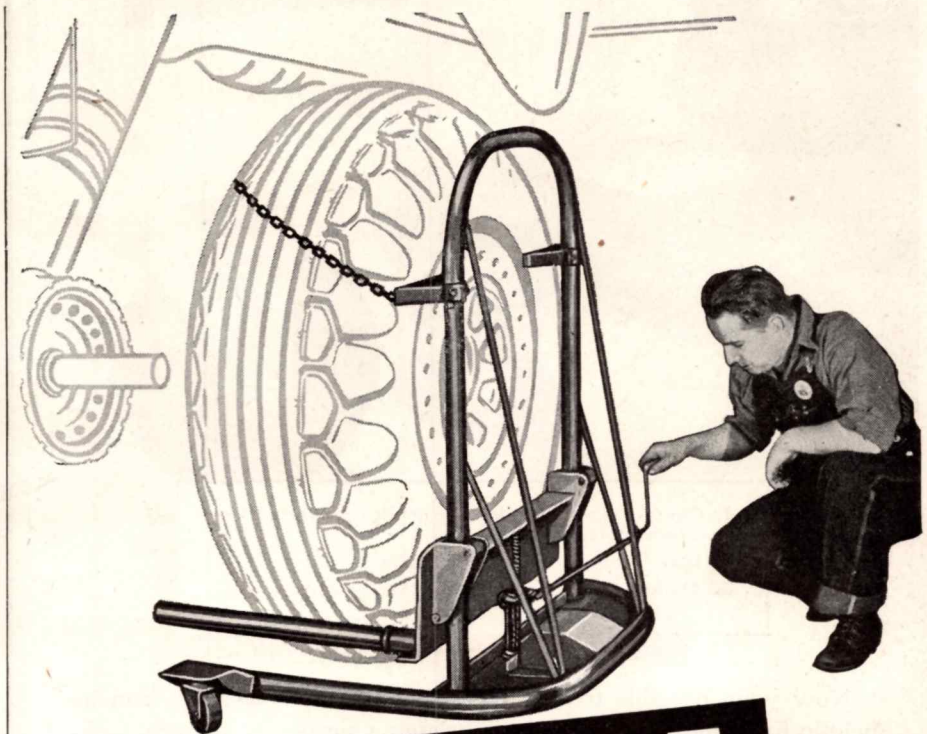
The manufacturer speaks merely of the internal combustion engine, but it should be

(*Continued on page* 323)



GLOBE WHEEL DOLLY

Makes Wheel Removal Quicker, Safer!

Mounted on 3 swivel casters and equipped with a simple screw-type jack arrangement for raising wheel to desired height, the Globe Wheel Dolly makes it easy to line up wheel with axle. Since the wheel rests on two *rollers* and is held in place by a chain, it can be readily rotated for indexing.

Jack arrangement of wheel cradle also permits one man, using the Globe Wheel Dolly, to pick up a wheel from a vertical position on the floor or ground without manual lifting or strain.

Dolly is capable of handling wheels up to 72" in diameter and weighing up to 1500 pounds. Weight of Dolly itself is 125 pounds.

For more information on the Globe Wheel Dolly or on the complete line of Globe Hydraulic Airplane Hoists, write or wire **Globe Hoist Co., Mermaid La. at Queen St., Phila. 18, Pa.**

GLOBE HOIST COMPANY

PHILADELPHIA, PA. DES MOINES, IOWA

NEW BASSICK POSITION LOCK HOLDS PORTABLE EQUIPMENT IN PLACE

1. Out of the way, under the truck—protected but accessible.
2. Easy to apply — easy to release.
3. Almost 12 sq. in. of friction locking surface contacting floor.

Now your portable trucks, work stands, machines, etc., can be held in fixed and steady position, through a simple, economical locking device.

The Bassick Position Lock, located in the natural position, is set by foot pressure on the operating lever. It is easily and quickly released by the toe of the operator's shoe.

Bassick Position Locks open up new opportunities to put machines and equipment on casters—move them to the work—and hold them steady while being operated or worked upon.

Six sizes for a wide range of operations. Write for Form No. 190; also request literature on the complete Bassick line. The Bassick Company, Bridgeport, Connecticut.

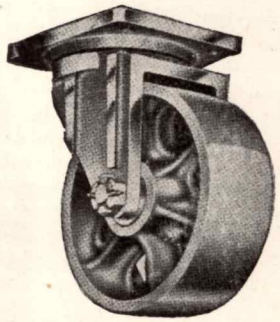
Bassick

MAKING MORE KINDS OF CASTERS

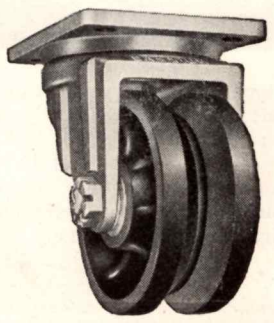
. . . MAKING CASTERS DO MORE

THE BASSICK COMPANY • BRIDGEPORT, CONNECTICUT
Division of Stewart-Warner Corporation, Chicago, Illinois. Canadian Factory: Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ontario

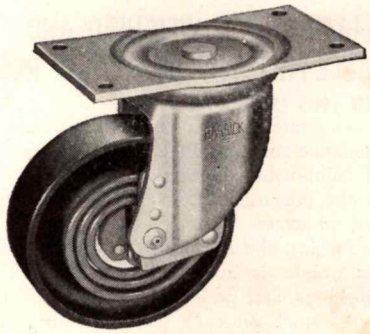
"Bassick makes the largest line
To serve you through the years
If you have a caster problem
Consult with Bassick engineers."



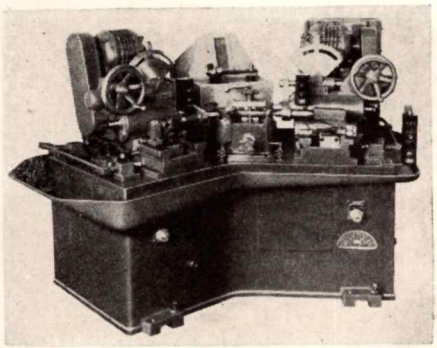
This giant, for instance — a super-heavy-duty Precision Caster will carry any load that can be moved on a given size of wheel.



Grooved-Wheel Caster for operation on angle floor track; modern economical materials handling on a production line basis.



"Floating Hub" absorbs shocks and eliminates damage to materials in transit, and protects floors.



(*Continued from page 321*)

particularly useful in the careful manufacture of the aircraft engine where conditions are so severe and accurate balancing is so vital.

Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit, Mich.

2000 TON MECHANICAL TRIMMING PRESS

AeroED 1906 (Sept. 1943) . . .

One of the largest mechanical trimming presses ever built was shipped recently.

The press, as illustrated, is capable of trimming the average run of forgings as they would come from a hammer of approximately 33,000 lb capacity. Operating at five strokes per minute, the machine is triple geared with twin drive on the crankshaft. A four-piece tie-rod frame construction was employed. A multiple disc flywheel type air friction clutch and brake with electric push button control is another feature of the giant weighing 450,000 lb. Specifications are as follows:

Stroke of slide—24 in, counterbalanced by air

Shut-Height-distance top of bed to slide, stroke down adjustment up—42 in

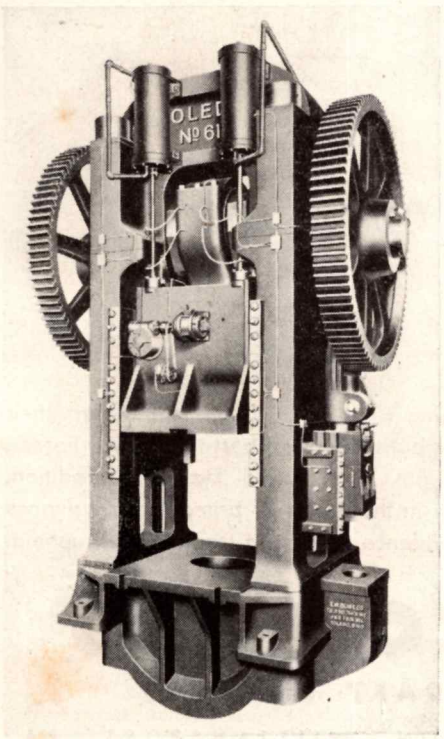
Slide area F to B X R to L 87 by 60 in

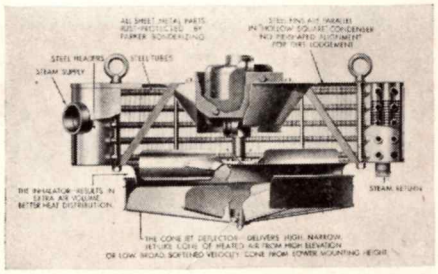
Bed area F to B X R to L 98 by 72 in

●

The design is robust and operation is accurate and rapid.

E. W. Bliss Co., 53rd St. & 2nd Ave., Brooklyn 23, N. Y.





VERTICAL DELIVERY UNIT HEATERS

AeroED 1907 (Sept. 1943) . . .

Vertical delivery unit heaters with steel condensers with range in capacity from 620 Edr (149,000 Btu/hr) to 2,500 Edr (600,000 Btu/hr).

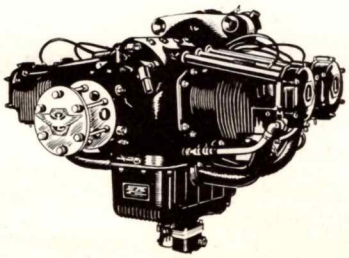
These vertical delivery unit heaters are available with standard "Con-Jet" deflectors or with "Modine Truncone" deflectors or Anemostats to meet most air diffusion requirements. The larger models may be mounted as high as 50 ft to 60 ft above the floor to clear crane ways and other overhead plant equipment. The steel condensers are protected against corrosion by a special coating of lead alloy. The tube and fin assemblies have been submerged in molten lead alloy to provide a corrosion resistant

(*Continued on page 325*)

Makin' the Grade... A LYCOMING FEATURE

WHEN THE "LINK" INSTRUCTOR SAYS — "YOU'LL DO!"

No. 3 of a series sketched from life by Clayton Knight



Lycoming Model O-290 four cylinder opposed 130 horsepower engine used in light aircraft for primary training and other special assignments.

MAKERS OF

Avco

PRODUCTS

The people of Lycoming take pride today in the part their engines play in turning out the world's best-trained Air Forces. Dependable engines are a years-old Lycoming tradition. Lycoming engines now in thousands of primary and advance training planes give evidence that it is a tradition well upheld!

LYCOMING

AIRCRAFT ENGINES

LYCOMING DIVISION — THE AVIATION CORPORATION, WILLIAMSPORT, PA.

(*Continued from page* 323)

coating over their entire surfaces. The fins are permanently bonded to tubes with metal, thereby sealing the heat transfer contact of fin to tube from the corrosive action of air and its impurites. Tubes and headers are braced with silver solder to form an integral unit of steam pressures up to 150 lbs/sq in.

•

The vertical delivery heaters are splendidly adapted for plant use, and will give good service under the most crowded and difficult conditions, and in the most corrosive factory atmosphere.

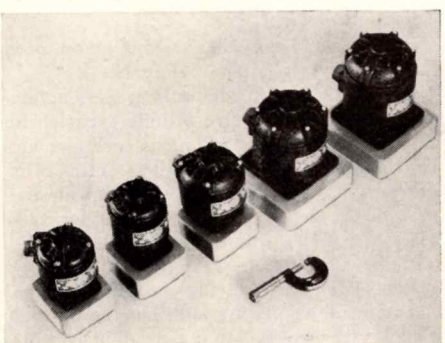
Modine Manufacturing Co., Racine, Wis.

ELECTRIC MOTORS FOR AIRPLANE USE

AeroED 1908 (Sept. 1943) . . .

New line of high frequency a-c electric motors for use in aircraft.

These motors operate on 3-phase a-c 400 cycles, and range in size from ⅛ hp to 15 hp. Synchronous speeds of 6,000, 8,000 and 12,000 rpm can be provided and lower speeds are available by means of integral type gear reducers. These motors are to be supplied with various types of flanges for mounting on pumps, blowers, actuators, and other equipment and can be furnished for both intermittent and continuous duty ratings. Bearings with self-contained seals are pre-



packed with low temperature grease to meet Army Air Forces specifications. Light weight magnesium alloy housings are used. Windings are stationary and can be well insulated. Standard AN type connectors can be supplied. The motors are finished in black wrinkle enamel and are fully streamlined.

•

Now that airplanes are equipped with generators of electric power, there is a good deal to be said in favor of alternating current equipment. Three phase high-frequency power, tends to light weight and the elimination of commutators and brushes reduces maintenance problems.

U. S. Electrical Motors, Inc., Los Angeles, Calif. and Milford, Conn.

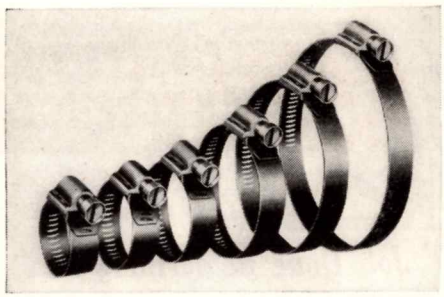
NEW HOSE CLAMP

AeroED 1909 (Sept. 1943) . . .

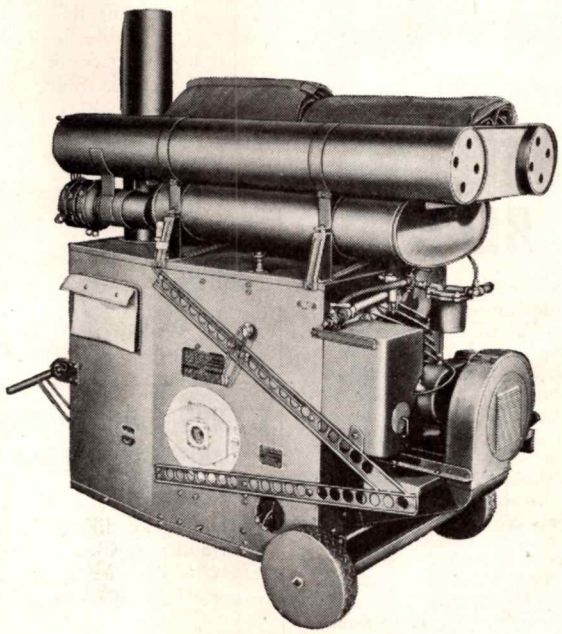
New hose clamp features novel take-up action, uniform pressure and safety cup on screw head.

The new hose clamp consists of a 9/16-in tempered steel band punched with holes corresponding to the teeth of a worm gear. These holes mesh with a worm in the housing welded to the fixed end of the band. The worm is turned by a screw driver, and the screw head on the worm is fitted with a safety cup which prevents the screw driver from slipping and puncturing the hose or damaging other equipment. All parts of the hose clamp are of high quality materials, heat treated as necessary to provide strength, durability, freedom from distortion, and freedom from friction between the parts.

Rapid action is obtained by a ten pitch thread so that full take-up is obtained with only a few turns of the screw driver. The belt-like tightening action produces a uniform tangential pull which does not distort the pipe and results in a leakless clamping action. By backing up the screw, the free



end of the band comes out of the housing. The clamp may then be sprung open and slipped over the hose in place on the pipe and the clamp can be easily removed in the same manner. This operating convenience



ANNOUNCEMENT is made by the Herman Nelson Corporation of the availability for commercial use of a self-contained and self-powered, portable heater. This heater was originally developed by the company and manufactured for the Armed Forces for use in a wide variety of applications; the principal use being the pre-heating of airplane engines in cold climates and the heating of maintenance shelters and other types of portable structures.

Suggested commercial applications are the pre-heating of airplane engines for airlines; heating, drying and similar uses in building construction, shipyards, drydocks, etc., and as a portable source of heat to be used wherever required.

The device is direct fired and available in a model which uses gasoline for engine and heater fuel or in a model which uses gasoline for engine fuel and No. 2 fuel oil as a heater fuel. A small gasoline engine mounted as an integral part of the unit drives a pressure-type propeller fan which blows air over the combustion chamber and out through two 12″ diameter openings in one end of the unit. The same engine drives a small centrifugal fan which provides air for combustion. Several models are available with various systems of collapsible, canvas duct work; the ducts being used to convey the heated air where required.

The Unit is equipped with two retractable wheels and when these are in a lowered position the unit can be moved in the manner of a wheelbarrow.

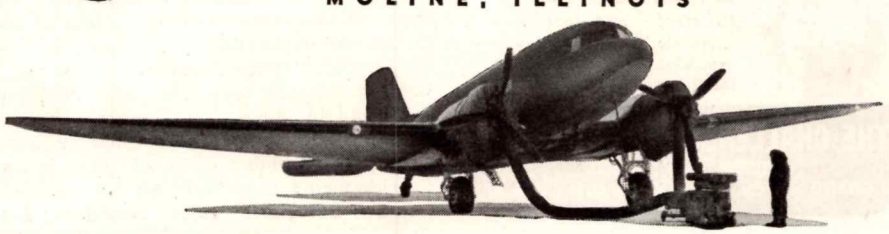
The unit is approximately 26″ wide, 56″ long, 42″ high and weighs only 290 pounds without ducts. Heating capacity is 250,000 B. T. U.'s per hour at 60° inlet. Discharge against ½″ W. G. is 2000 cubic feet per minute.

herman nelson moline illinois

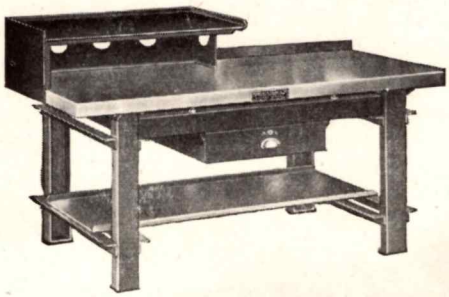
THE HERMAN NELSON CORPORATION

Manufacturers of Quality Heating, Ventilating and Air Conditioning Products

MOLINE, ILLINOIS



To Get the Job Done in a Hurry . . .



use CHALLENGE WORK BENCHES

● They have what it takes for faster, full-time production—**Cast-Iron Top** that stays smooth and accurate; will not warp, shrink, splinter, or burn . . . **Tool Box Shelf** that provides a place for the tool box where it can be opened without moving anything on the bench top . . . **Leveling Screws** on two full-length braces under the table to keep the working surface level . . . **Steel Drawer** with strong lock.

Challenge Work Benches are ruggedly built. The surface and all four sides of the cast-iron top are carefully machined at right angles. The under-side is heavily ribbed for extra strength.

The legs are firmly braced, and the braces are high enough to permit the use of a standard lift truck, if the bench needs to be moved.

Challenge Work Benches are made in four sizes, three styles. Ask for details and prices at once!

CHALLENGE
products also include **Lapping Plates, Surface Plates, Layout Plates,** and other Precision Equipment for Tool and Machine Industries.

LATEST CATALOG
illustrates and describes complete lines of Challenge Precision Equipment. Send for it today! 415

THE CHALLENGE MACHINERY CO.
1893 50TH ANNIVERSARY 1943
GRAND HAVEN, MICH., U. S. A.

is obtained with no loose pieces in the clamp unit. While a line of fourteen sizes is provided to cover hose from ¾ in to 4 in nominal sizes, it is possible for six sizes of the hose clamp to cover the same range. The band has a total take-up of 3 in (2 in and 2½ in on the smaller sizes) and can be tightened considerably below its nominal size by letting the free end of the band come through the housing a couple of inches.

The new hose clamp is self-locking as a result of the worm and worm gear action and it is claimed that it is virtually impossible to loosen even with severe vibration as long as the band is under tension. Lock wires are not necessary and the clamp is operated by a screw driver as the slotted head permits maximum compactness of the take-up mechanism. The safety cup feature not only prevents slipping of the screw driver but also makes it possible to find the screw slot easily in the dark or in cramped or concealed locations. Since the screw is hardened, the slot will not be damaged by repeated use.

●

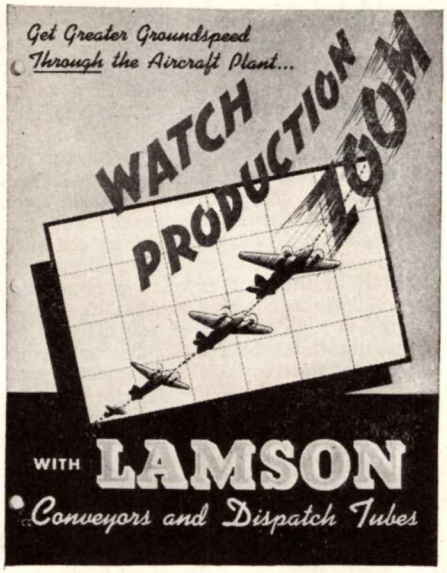
The basis of design was set forth in AAF specification No. 25529 and all the important requirements of this specification have been met and in some details exceeded by a wide margin.

Aircraft Standard Parts Co., 1711 - 19th Ave., Rockford, Ill.

STEPPING-UP WAR PRODUCTION WITH LAMSON OVERHEAD CONVEYORS

AeroED 1910 (Sept. 1943) . . .

A production ceiling imposed by limited floor space and manpower shortages may be eliminated by the installation of Overhead Conveyors which, by moving in a continuous



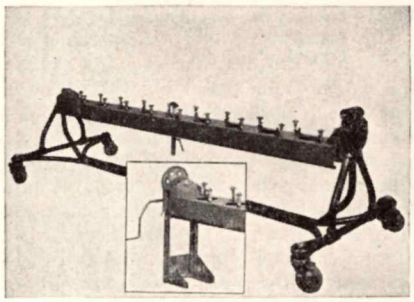
flow along the ceilings, can be used in all stages of production from the lifting of incoming raw materials to the removal of finished products for shipping or storage. These overhead conveyors in connecting floors and buildings into a smooth production flow have accomplished much in stepping-up war production in all types of industries including aircraft, aircraft engines, arsenals, autogiros, cables, cartridges, fire extinguishers, food, motors, oxygen cylinders, pontoons, powder, shells, steel, stoves, and watches.

●

We read of some interesting applications. For example in a leading airplane factory, the overhead conveyors lift raw materials and finished parts out of the aisles and move them along the ceilings, thus saving valuable floor space. Elsewhere the production of oxygen cylinders was increased by installing infra-red drying lamps overhead (there being no room elsewhere) and bringing cylinders between the lamps by means of the conveyors—which seem to have endless possibilities.

Lamson Corp., Syracuse, N. Y.

CYLINDER STAND



AeroED 1911 (Sept. 1943) . . .

Cylinder stand for the assembly and overhaul of aircraft engine cylinders.

In the standard model, a long box contains nine openings to receive cylinders, each with a pair of clamps to lock in the cylinder and hold it in a rigid position. The entire cylinder box may then be rotated to any desired position to secure complete access for valve assembly. The stand is available in both portable and stationary models.

It is claimed that savings in time and labor can be made by its use and that the portable model will meet a definite need in continuous assembly lines and in the overhaul and repair of engines in service where dollies are now used.

●

We believe that there is another advantage in the use of this stand: more comfortable working position and hence reduction of fatigue.

Motor Rebuilding Specialties, 2634 S. Michigan Ave., Chicago, Ill.

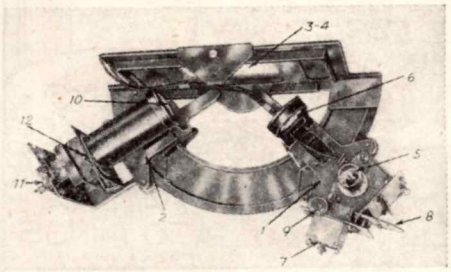
PRECISION INSTRUMENT FOR MEASURING GLOSS

AeroED 1912 (Sept. 1943) . . .

A Geniophotometer which measures high, medium, and low gloss of plane surfaces of materials over 2⅛ by 3-in in size.

The results are in terms of the I.C.I. Normal Observer and the I.C.I. Illuminant C. The kinds of gloss measured with this instrument are specular gloss, distinctness-of-image gloss, absence-of-bloom gloss, and other optical properties of surfaces of all kinds. It is especially useful for A.S.T.M. method D523 for measuring specular gloss of paint finishes. Illumination is adjustable from minus 30 degrees to plus 70 degrees

from the normal. The receptor is adjustable from plus 30° to minus 70° from the normal. Angles may be read to 1 minute of arc and measurements of relative apparent reflectance from zero to 100% can be made. A complete gloss curve of a high-gloss sample can be obtained in approximately 30 minutes.



The instrument has sufficient sensitivity and wide range to measure relative apparent reflectance from high gloss to flat gloss without the use of neutral filter or wedges. The instrument operates on 110-120 v 60 cycles (controlled frequency) single phase a-c., and is unaffected by fluctuations in the line voltage. It need not be operated in a darkened room. The entire outfit weighs approximately 55 lb, and consists essentially of four main components (1) geniophotometer (2) reference plate and sample holder (3) control and measuring unit (4) galvanometer.

•

This is a fine instrument for measuring the properties of paint finishes, enamels, lacquers, metals, wood, plastics, glass etc. on a thoroughly scientific basis. Besides measuring gloss, it can be put to work in ascertaining the hiding power of various finishes; the cleansing power of soap; the index of refradion; glare; and the resistance of surfaces to abrasion and wear.

American Instrument Co., Silver Spring, Md.

OIL HEATER

AeroED 1913 (Sept. 1943) . . .

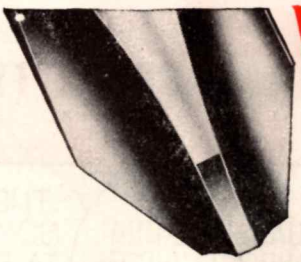
New type of electric heater for warming up lubricating oil at arctic bases.

The heater is an immersion heater composed of two long coils that heat up considerably and thus keep the lubricating oil in the crankcase or oil tank from freezing into solid cakes.

•

A simple device but one which is vitally needed for cold weather flying.

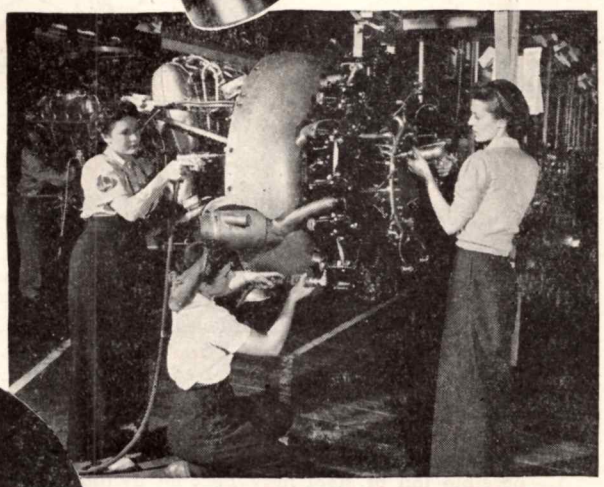
General Electric Co., Schenectady, N. Y.

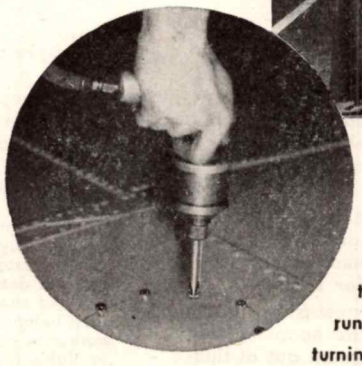


WOMEN WORKERS AND ALL GREEN HANDS can drive HOLTITE —PHILLIPS— SCREWS and BOLTS

with speed, safety and efficiency! Basic training time for inexperienced workers is cut to a minimum and production increased without hazards of injuries, spoiled work or burred heads.

The illustration below shows a specific instance of the proficiency in power driving that can be attained by women workers. At the Consolidated Vultee Aircraft Corporation in some departments power tools replace hand-driven screw drivers and wrenches commonly used when men were employed. This production - boosting operation has been made possible by the adoption of recessed head screws. By this modern fastening practice, experienced workers can cut fastening time up to 50% and more.





When Speed Nuts are used with HOLTITE Sheet Metal Screws in place of machine screws, another saving in production time is effected, as the small tapered point permits a quicker start when nuts are run on. The smooth threads with faster lead reduce turning time and provide a tighter lock to defy vibration.

HOLTITE "Thread-Forming" Sheet Metal Screws eliminate tapping operations by cutting their own threads in the material as they are driven in. For all metal-to-metal fastenings, specify HOLTITE Type "A," "Z" or "C" sheet metal screws.

CONTINENTAL SCREW CO. New Bedford, Mass., U.S.A.
BUY MORE WAR BONDS

"PUT ON THE PRESSURE AND SPOIL THE FILE," SAYS POP

UNAVOIDABLE as they are, wastes on the battle fronts are terrific. They make it all the more necessary to ***prevent*** wastes on the home fronts. In order that every possible ton of steel may become available for implements of war, every possible pound of steel must be saved by stretching the serviceability of the tools required to build them.

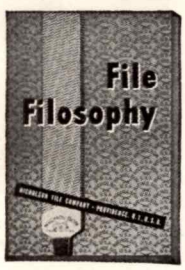
In no other shop tools can there be a heavier percentage of steel wastage through ***mis***use than in files. Nor more serviceable life added by ***proper*** use, proper care and proper selection of ***The right file for the job.***

Too much hand pressure is the commonest filing fault. Consequently, too much "pressure" can scarcely be exerted by foremen toward keeping workmen out of this wasteful habit.

The superior cutting and lasting qualities built into Nicholson and Black Diamond Files will prove that it pays to specify these world-famous brands. To help bring out the proof, Nicholson offers industrial managements this really useful book:

"FILE FILOSOPHY"—*FREE*

The most authoritative book of its kind! Understandably written and profusely illustrated, "File Filosophy" is a most valuable handbook. It describes the more widely used regular and special purpose files, and is particularly helpful in training the less-experienced worker in proper file use, care and selection. Available for the asking—for purchasing and production heads, foremen, key mechanics.



NICHOLSON FILE COMPANY • 43 ACORN STREET, PROVIDENCE 1, R. I., U. S. A.

(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON FILES

FOR EVERY PURPOSE

NICHOLSON U.S.A. MADE IN U. S. A.

Vital TRADE LITERATURE

Invaluable design and manufacturing information is given in the selected trade literature mentioned on this and following pages. It is available to you for the asking—just fill out the form on page 285. The Editors suggest that you take advantage of this opportunity to secure latest data on vital subjects.

AIRCRAFT FINISHES TO GOVERNMENT SPECIFICATIONS

AeroED 1914 (Sept. 1943) . . .

Ten supplementary pages for the "United States Government Specification Finishes Catalogue."

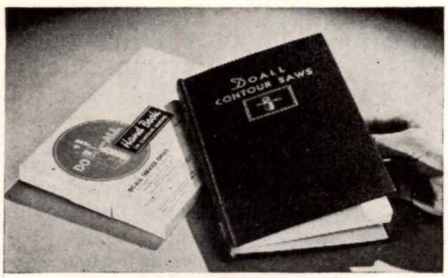
These well-organized reference pages cover the uses, application, colors and drying time of camouflage enamels, liquid wood surfacers, aircraft wood finishes and protective coatings, liquid wood sealers, heat-resisting enamels, lustreless lacquer enamels for ammunition, and clear or pigmented lacquers. In addition specific properties such as resistance to water, gasoline or alcohol, durability and flexibility are covered. Other less familiar properties discussed include Specular gloss, photographic infra-red reflectance, film property, penetrating properties, coating anchorage, etc.

•

Army-Navy Aeronautical Specifications are fully met by this excellent line of finishes and the pages of information are well organized for the benefit of purchasers and users of these materials.

Lacquer & Chemical Corp., 214-224 Fortieth St., Brooklyn, N. Y.

TEXTBOOK ON CONTOUR SAWS



AeroED 1915 (Sept. 1943) . . .

A 265-p well-illustrated textbook on contour saws gives comprehensive instruction in the art of contour machining and cutting tools.

The new handbook is of special importance to industry and the machinist handling contour sawing and filing equipment. It describes the latest techniques for contour machining; internal and external three dimensional parts for short run forgings; multiple identical parts in one operation for short run stampings and facilities for handling both massive or small jobs. Those not having contour machining equipment will find the book contains much information to help them solve their shaping problems through this machining process.

Eighty-five pages of the book show how contour machining replaced conventional machining to save both time and material on the production line as well as on special jobs. Another twenty-six pages illustrate and discuss methods used to find the best type of saw, saw velocity and feed pressure for cutting any material of any thickness most economically. Over 80% of the text is illustrated by pictures with charts and diagrams giving easy selection of proper speeds and feeds in the shaping of all basic materials; ferrous and non-ferrous metals and alloys, plastics, wood, fibre board, rubber, etc. A forty-four page section at the back of the book gives specific information on machine tools and machine shop practice for the student or learner. It also shows the facilities for free training in contour machining. The textbook is shop coat-pocket size, bound in the conventional manner with blue embossed covers to resist smudging and wear from hard usage.

•

Men on the production line from the cut-off saw operator to the best toolmaker on the jig boring machine will find the book of value. Northwest Airlines use these techniques for making propeller wrenches, special calipers and other maintenance parts, to mention but one aircraft application out of many.

Doall Service Co., 1201 Thacker St., Des Plaines, Ill.

DIMENSIONAL CONTROL

AeroED 1916 (Sept. 1943) . . .

New revised edition of classroom charts on "Dimensional Control."

A portfolio of forty large illustrated charts on "Dimensional Control—Theory and Industrial Application" for use in classroom training of inspectors is now available. The charts are 27 by 32 in and are bound between two heavy covers which act as a supporting easel. Included is a 28-pg booklet outlining a talk to be given with the charts presenting an overall picture of gaging practice in modern industry. Covered by the charts are basic definitions, the principles of GO and NOT GO gages, wear allowance,

gagemakers' tolerances, gaging policy, fixed gages and precision measuring instruments. This portfolio is a revised edition of a similar set previously distributed. The principal revision of the former set is the addition of several charts on unilateral and bilateral tolerances, gaging policy, and new precision measuring instruments.

•

The charts are truly instructive and are being used by hundreds of industrial concerns and many educational institutions.

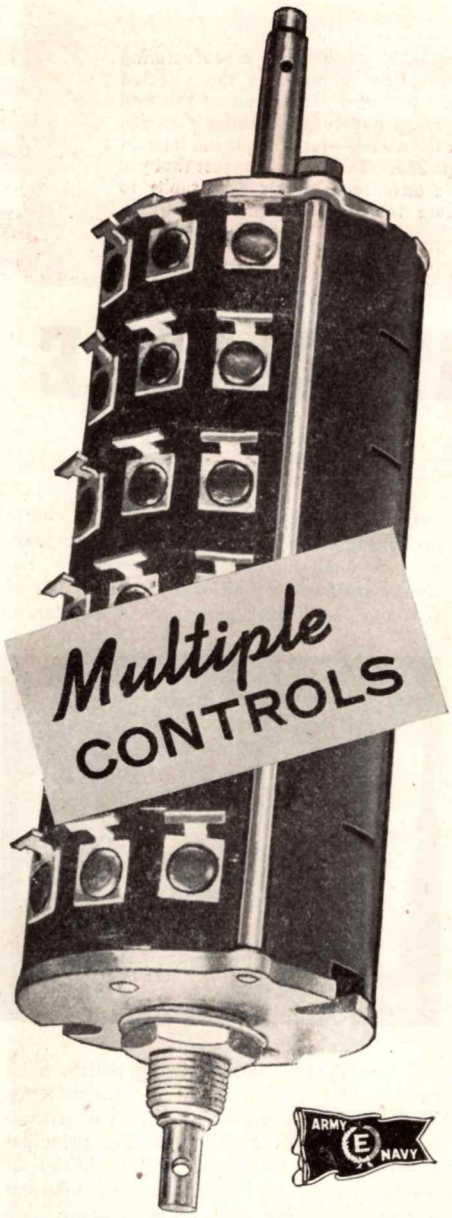
Sheffield Corp., Dayton, Ohio

REPAIR PLATFORM

AeroED 1917 (Sept. 1943) . . .

16-pg, illustrated manual for assembling knockdown rigid type service and repair platforms for aircraft work.

The aircraft service and repair platform is composed of three main sections: the master bottom section, the intermediate section and the master top section. The master top section is always the uppermost section for heights of the work platform above seven feet. This platform may be built up to twenty-five feet in height with the addition of intermediate sections, each three feet in height. As each part of the entire platform is color coded and matchmarked and all parts are numbered in approximate sequence of their installation, assembly is relatively easy. The manual includes simple yet ade-



★ An entirely new design for tandem controls. New mold provides unit casings that nest and lock together. Metal end pieces and tie-rods insure rigid assembly—even up to 20 units in tandem. Single shaft passes through and locks with rotor of each control.

Each section accurately wound to precise circuit requirements—resistance, taper, taps, hop-off. Interlocking resistance ratios provide any desired voltage or current at given degree of rotation. These Multiple Controls are now in regular production and meeting the most rigid multi-control requirements.

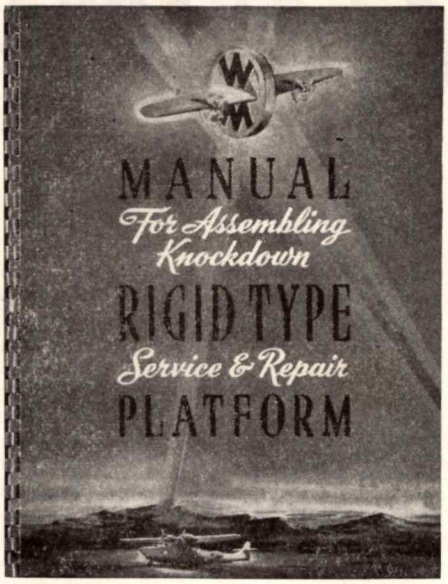
★ Send us that problem . . .

CLAROSTAT Controls and Resistors

CLAROSTAT MFG. CO., Inc. · 285-7 N. 6th St., Brooklyn, N. Y.

quate instructions and diagrams for the assembling of each section.

For proper alignment of the entire platform, each section must be set up by tightening the nuts with fingers only and by placing the planks in position and inserting plank bolts minus the nuts. After the section is aligned the nuts may be wrench-tightened. The planks serve as a working surface from which the next section is assembled. To move the platform on rough ground or through sand and mud the legs should be detached and caster should be screwed up



snug against the bottom of the base. The shipping boxes, sturdy enough for future re-shipment of stand, provide an excellent storage place for additional intermediate sections, wrenches, shipping bolts, and instructions.

The manual also includes illustrations of other aircraft equipment, i.e., the Universal Repair Stand (Folding Type), the Quick-Change Engine Stand, the Tail Lifting Truck, the Dissembled Wing Dolly, the Wingroot Dolly, and the Fuselage Legs.

•

The illustrations in the manual are most enlightening, and prove beyond cavil how handy these platforms are in application to well known airplanes such as the PB-2Y. We note particularly handy propeller wells at foot elevation and easy access to all parts of the engine. The instructions for assembly are particularly clear. These accessories should be invaluable at every busy maintenance or service depot.

Wolfe & Mann Mfg. Co.,
Aircraft Equipment Div., Baltimore, Md.

BASIC INFORMATION ON COATED ABRASIVES

AeroED 1918 (Sept. 1943) . . .

28-pg, cross-indexed and illustrated Service Book, size 5-in by 7-in on coated abrasives.

This handbook gives the fundamental information on the manufacture, storage, and usages of coated abrasives. It also includes the necessary elementary facts, i.e., what constitutes a quire and a ream of sandpaper; the number of yards in a standard roll; how the different grit sizes are produced and how they compare with one another.

•

While the handbook was originally produced for use by distributor salesmen of the Company, it will serve the needs of all those concerned with the use, purchase and storage of such abrasives.

Behr-Manning Corp., Troy, N. Y.,
Div. of Norton Co.

LUBRICATION CHART

AeroED 1919 (Sept. 1943) . . .

Aircraft lubrication chart for use in servicing aircraft and aircraft engines.

The chart is so assembled that revised or new pages may be added to it as new lubricants become available or new equipment is developed. While in use the chart may be conveniently hung on the nearest wall for ready reference.

It is divided into three main parts. The first lists in detail the lubricants available and their various applications. These include aviation oil and aviation gasoline together with their respective government specifications. The second part is a chart of aircraft engines, the minimum grade gasoline necessary for satisfactory operation of each engine and the recommended oil. The latter is sudbivided into three categories of temperature range; normal, 70°F. to 20°F.; tropical, above 70°F.; and frigid, below 20°F. The third part is made up of a number of lubrication diagrams. Each diagram has an isometric drawing of the airplane type to be lubricated. All points of lubrication are clearly shown and labeled. The type of lubricant is indicated by a number inside a square or a circle, its means of application, whether by grease gun or hand, the recommended lubricant and the number of flying hours allowable before re-lubrication is necessary are also shown on the chart.

•

The new chart is an excellent counterpart to the lubrication manuals which are used widely in automotive service stations, should help even the most experienced aircraft mechanic and will be indispensable for newcomers in the field.

Standard Oil Co. of New Jersey, 26 Broadway,
New York, N. Y.

HAANDBOOK OF PRINT-MAKING AND PROCESSING

AeroED 1920 (Sept. 1943) . . .

A newly issued, illustrated 42-p Handbook of Print-Making and Processing, covering the use of blueprints, direct process-prints, sepia prints, and reproduced tracings, listing the advantages of each.

The Handbook describes in the fewest possible words, the uses to which various types of prints are most adapted and the methods by which they may be obtained. In the opening sections of the book the four generally used methods of print-making are discussed. These include blueprints, and blueline prints, sepia negatives and brownline prints, direct process prints or whiteprints, and reproduced tracings.

Blueprints, the most commonly used method of reproduction, are discussed together with different methods of producing them for various volume requirements. Direct process, or whiteprints, are covered in the same manner as blueprints. They have certain advantages, particularly when production requirements are small; paper cost is of little consequence and permanency of the print not of prime importance. Sepia negatives, or brownprint negatives, are permanent negative reproductions from which thin or heavy brownline and blueline prints are made. They are produced by the same equipment as blueprints, but use different chemicals. They are not bulky and are often used as master copies in place of original drawings. Separate files of these negative master copies are often used as a loss insurance for original tracings. They can be blueprinted and used to make new tracings when desired. Government departments and large contractors use sepia negatives to provide bidders, suppliers, and sub-contractors with necessary data specifications. Many government contracts also specify that one or several sets of sepia negatives be furnished with machines or materials. Blueline prints are permanent positive reproductions on blueprint paper or cloth. Using a sepia negative or photo negative for the original, they are produced on regular blueprinting equipment. Brownline prints are permanent positive reproductions on sepia paper or cloth, and are also made on regular blueprinting equipment.

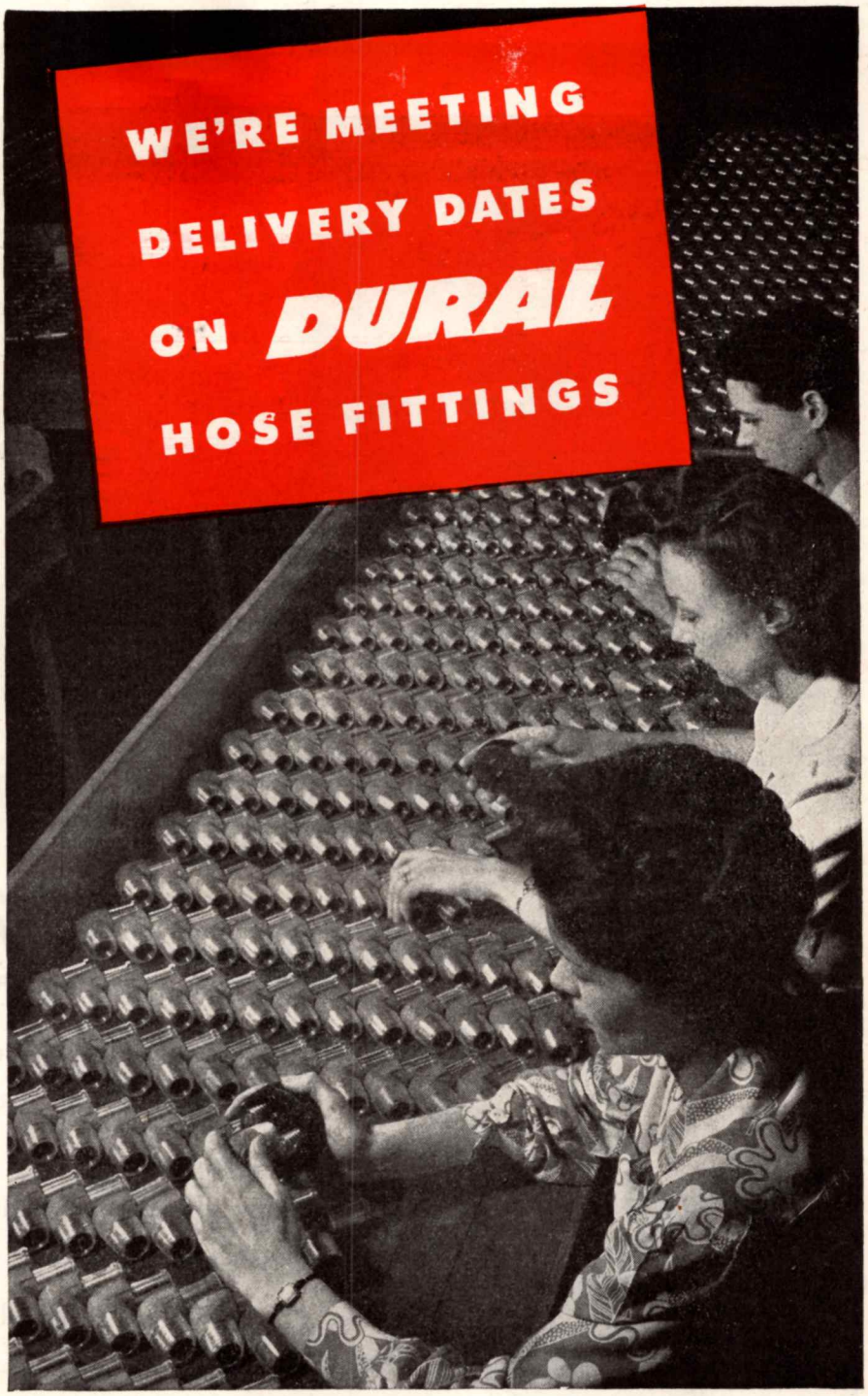
Permanent Prints

Reproduced tracings are permanent prints or copies of original pencil drawings, tracings, blueprints, or direct process prints. They are used to save time, eliminate slow and expensive hand tracing, and to make better blueprints. They are also used to replace worn or dirty tracings, to save time where major changes must be made in the original, to provide duplicate tracings for government sub-contractors or other agencies, and to provide a tracing from a blueprint. They are made by a number of different methods—from sepia negatives on slow speed emulsion reproduction cloth, by using darkroom photographic materials, and by using new subdued-light photographic materials.

Comparative advantages of the various methods of print-making, of continuous yardage production as opposed to cut-sheet printing, and of the different types of processing equipment are dealt with in detail.

Revolute's revolving contact principle of printing is also thoroughly described, as are the different types of lamps used for exposing the sensitized materials. Several new features to be included on the Revolute 3H are presented for the first time in this volume. All are outgrowths of today's greatly increased need for high speed production. These features include squeegees placed before and after the chemical bath to minimize the tendency for water to cling to the paper and thus dilute the chemicals when operating at high speeds. The Quick-Change chemical applicator, which was originally intended to simplify the change from blueprints to sepia prints by tilting the paper into either one of two trays, has now been arranged so that it can be used as before or, by filling one tray with chemical and the other with

(*Continued on page* 333)



Tooled for high speed, accurate production, we're turning out DURAL AN hose fittings at a rate that assures prompt and early handling of your order.

We are manufacturing DURAL bulkhead hose fittings for pressurized cabins —AN 846, 848 and 849, and the balance of the AN 840 to 847 series.

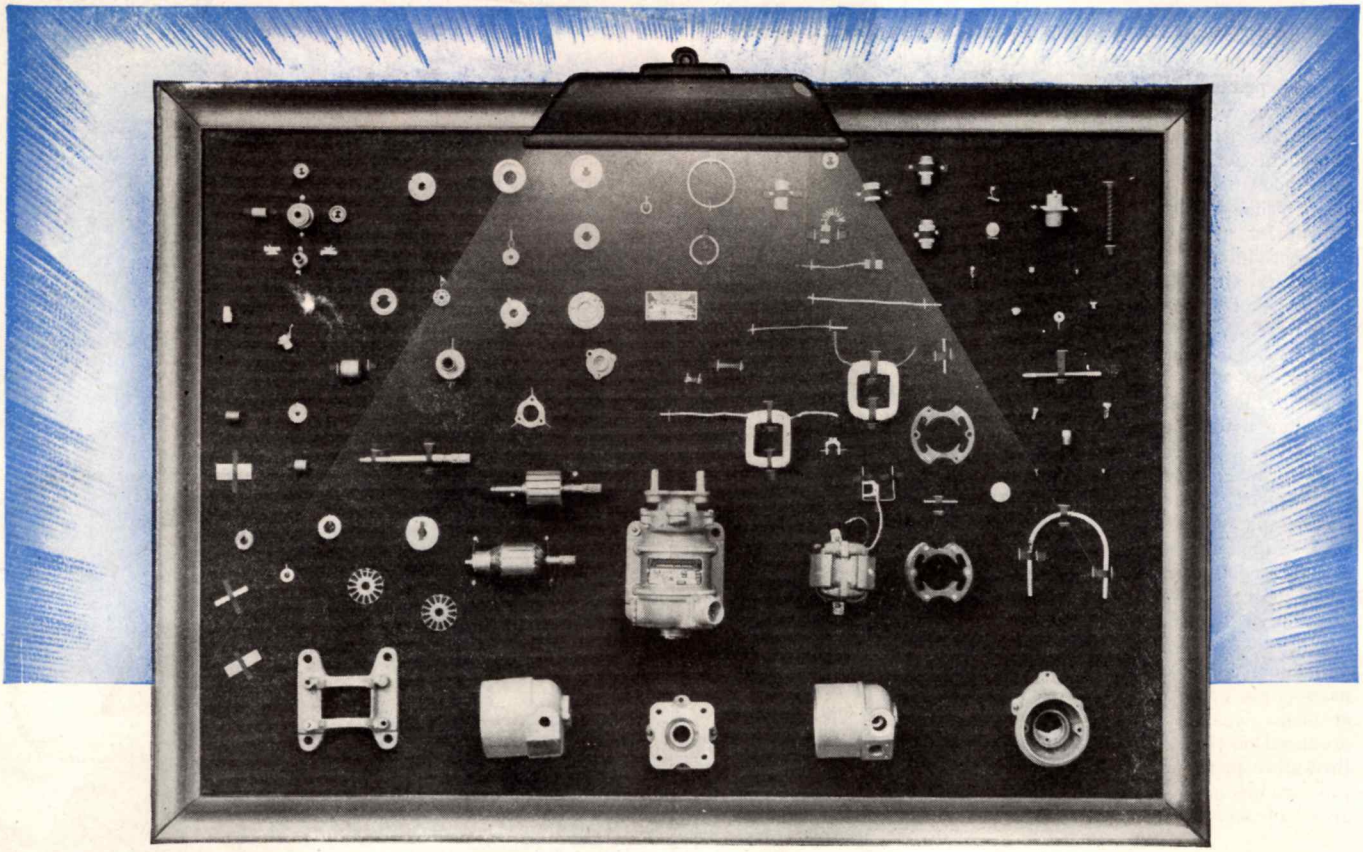
Blueprint specifications and uniform high quality are maintained by complete inspection after each operation, and a final inspection, which checks thread tolerances and all inside and outside dimensions. Hartwell hose fittings, except those made of barstock, are pressure tested by air, under kerosene, to 100 lbs. gauge pressure.

For emergency deliveries of DURAL AN hose fittings, wire our Los Angeles office, or the branch office nearest you.

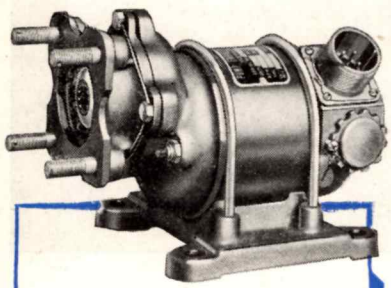
HARTWELL **AVIATION SUPPLY COMPANY**

Aircraft Production Parts

3417 CRENSHAW BOULEVARD, LOS ANGELES, 16 · DALLAS, TEXAS · DETROIT, MICH. · KANSAS CITY, KAN.



INSIDE STORY OF A *Motor*...



THOROUGH ENGINEERING is the basic factor behind the successful operation of this aircraft fuel pump motor and many other special application motors we have designed for all types of equipment.

✱ Precise inter-relation of these many intricate parts in an aircraft motor is what we mean by *thorough engineering.*

Every part carefully designed . . . accurately made . . . to insure dependable performance under the extremely severe operating conditions of this application.

Building motors with rugged "physiques" yet compact in design and low in weight results from our many years' experience in the special application field.

This experience, covering all types of fractional horsepower motors, is available to your engineering department.

THE BLACK & DECKER ELECTRIC CO.
KENT, OHIO

Black & Decker

FRACTIONAL HORSEPOWER SPECIAL APPLICATION **MOTORS**

(*Continued from page* 331)

water, an additional water wash is obtained.

Announcement is also made in the Handbook of the new Revolute 8Q Printer which has been designed to meet the requirements of industries whose print production has graduated from small to the intermediate stage. It occupies small floor space, will expose blueprints, direct process prints, and sepia negatives up to 54 in wide. Speeds range from 6 in to 32 lineal feet per minute. It incorporates revolving contact and uses a quartz high pressure mercury vapor lamp, drawing approximately 75 watts per lineal inch.

Another complete section of the book is devoted to reproduced tracings, the demand for which is directly attributable to the war, and tells how and where reproduced tracings are used, how they are made, and the equipment used. For such work, the new Revolute 8F Continuous Copier is recommended.

•

No book or leaflet or text has ever appeared to describe, within the same covers, all the major methods of reproducing drawings and some confusion exists as to their properties and uses. Nothing is better calculated to spread knowledge of the subject and remove such confusion than this excellent text. It will be of value to all those engaged in reproduction as well as to engineers, shop men and others using the results of reproduction. In particular it should answer such questions as: How to choose the right process? What paper? What is the Revolute revolving contact principle? How is correct lighting secured? etc. —The illustrations are apt and excellent. The uses of the equipment include leading aircraft companies.

Paragon-Revolute Corp., 77 South Ave., Rochester 4, N. Y.

KEEPING TELEPHONES IN TRIM

AeroED 1921 (Sept. 1943) . . .

12-pg, illustrated booklet with seventy-five useful and specific tips on maintenance of telephone equipment.

This booklet on "preventive maintenance" explains in detail the care of switchboards, telephones, cords, power equipment, outside lines, etc. These suggestions contributed by telephone companies throughout the country are calculated to aid operators of telephone systems affected by wartime curtailments to maintain peak efficiency and, at the same time, to make equipment last for the duration.

•

The booklet has been received with enthusiasm by many large users of the telephone and is another fine example of how intelligently the telephone and its associated industries are meeting war time difficulties.

Kellogg Switchboard & Supply Co., Chicago, Ill.

ELECTRIC EQUIPMENT MAINTENANCE

AeroED 1922 (Sept. 1943) . . .

A new 372-p book on how to maintain electric equipment.

The new book includes more than 500 illustrations, dozens of new tables, many hitherto unpublished charts and recommendations prepared and checked by design, application and field engineers. A summary of contents indicates the remarkable scope of the new book which is divided into some twenty-one sections, obtainable separately.

•

A good many of these sections are of specialized interest and deal with such topics as Battery Trucks, Diesel-electric locomotives, Electric Furnaces, Turbines, etc. But other sections are of more general interest, applicable to every industry including the aircraft plant and dealing with the maintenance of industrial control, cable and wire, regulators, switchgear and the like.

General Electric Co., 1 River Road, Schenectady, N. J.

A-C ELECTRONIC DRIVE

AeroED 1923 (Sept. 1943) . . .

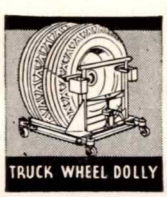
4-p illustrated booklet, B3256, describing an electronic adjustable-speed drive which provides wide stepless range, automatic speed regulation and smooth fast acceleration with automatic current limitation.

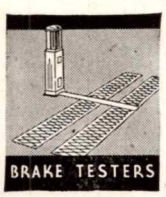
Charts show motor speed characteristics for a 20 to 1 speed range, 10 to 1 speed range, and constant speed. In the new drive, incoming a-c power is converted to direct current by thyratron tubes, which supply the direct current to armature and field circuits of the d-c driving motor. A potentiometer in the control station varies the voltage of the current by shifting the phase of the grid control voltage of the

FRANKLY, there are a few things Weaver engineers haven't found out about wheels . . . but very few. Thirty years of research and designing equipment for servicing automobiles has taught us most of the secrets of wheel balance, brakes, alignment, etc. This engineering know-how is now serving all branches of the armed services, including the Air Force. It is available to the Aviation Industry, too. Plane wheels are subject to the same dynamic forces present in automobile wheels . . . forces which we helped bring under control. Today we are planning the equipment that airplane service mechanics will be using for maintenance of tomorrow's planes. We invite you to help us in this planning by bringing your wheel problems to us for a solution. Sooner or later you'll get to know Weaver Airplane Service Equipment, and the sooner, the better for both of us. Outline your problem in a letter; we may be able to help you immediately. Or, better still, ask to have our field engineer call and talk things over.

ARMY E NAVY

WEAVER MANUFACTURING CO.
SPRINGFIELD, ILLINOIS





HUNTER HEATER ADAPTABLE FOR LAND AND AIR SERVICE UNITS

High or Low Test Gasoline Burner Solves Problems in Heating Field Equipment; Trucks, Trailers and Aircraft

UTILIZES "SEALED IN STEEL" FLAME

CLEVELAND, OHIO—The problem of efficiently using all types of gasoline in one simple device for heating, has been solved by a group of Cleveland engineers. As a result, equipment made for use of the armed forces now can be fitted with heating units utilizing whatever gasoline is at hand, ordinary truck gasoline or 100 octane aircraft fuel.

Hunter Universal Gasoline Heaters are serving the armed forces in many ways which cannot be described, but it is an uncensored fact that they can be successfully used for heating and ventilating trailers, busses, trucks, mobile photo laboratories, field hospitals, truck or trailer-mounted field repair shops, shelters for radar and radio equipment. Also for heating and ventilating tents, portable houses, field or permanent barracks for officers, and similar housing. Certain models can be used for standby heating of truck or plane engines to assure starting in severe weather, and for cabin heating in busses and aircraft.

Wherever personnel or equipment goes, the same type of gasoline that takes them there can be used for fuel in Hunter Universal Gasoline Heaters. The simple gasoline burner also is available in an automatic water heating tank, ideal for trailers or mobile service units.

To make this handy heating available to everyone manufacturing service equipment, as well as to procurement officials in various branches, Hunter and Company have an engineering group whose job is to search out new applications of their basic heating and ventilating units, and to work out adaptations for any specific heating and ventilating problem. A bulletin is available which briefly describes the standard models, the basic principal of the burner and the general purposes for which they are suitable. It is called 'Bulletin HA-2".

Full information, or a consultation with a representative, may be had by writing or wiring Hunter and Company, 1554 East 17th Street, Cleveland 14, Ohio.

thyratrons. Both armature and field circuits are controlled by one dial on the control station.

Also pictured is a Mot-O-Trol control station with two dials, for applications requiring forward and reverse speed. Other features of the Mot-O-Trol listed and discussed in the booklet are the few rotating parts; little vibration; stable operation with full torque at low speeds; ease of mounting; constant torque-zero to base motor speed; and finger tip speed control.

•

Electronics applied to industrial drives have revolutionized the control, range and flexibility and the above is an excellent example.

Westinghouse Electric and Mfg. Co., Dept. 7-N-20, East Pittsburgh, Pa.

PREPARED ATMOSPHERES

AeroED 1924 (Sept. 1943) . . .

12-pg, illustrated folder under the title Primer of Prepared Atmosphere.

The bulletin answers questions as to the reasons for different types of prepared furnace atmospheres, how they are prepared, their application and relative cost. The effect of atmospheric gases upon steel is summarized for average annealing and hardening temperatures. Also included are photographs of the generators of the atmospheres and diagrammatic illustrations of their operation. In addition there are in the bulletin charts of the compostion, reaction, and application of the various prepared atmospheres.

•

The bulletin will be read with attention not only by professional metallurgists but by all those concerned with the annealing, heat treating or hardening of metals.

Surface Combustion, Toledo, Ohio

CALCULATOR FOR MACHINING OPERATIONS

AeroED 1925 (Sept. 1943) . . .

An ingenious chart that simplifies calculations for machining operations.

The chart is composed of a series of linear scales of pertinent production information spaced one beneath the other. They include scales of cutting speed, diameter of work, RPM, feed-inches per revolution, feed-inches per minute, length of cut, cutting time per piece, percent cutting time, production in pieces per hour.

By drawing a series of straight lines in accordance with the directions included with the chart, greatest production can be determined, or if an operation is not being performed as efficiently as desired, the calculator will usually indicate where inefficiency in the tool set-up exists. It can be used as a permanent record of the cutting conditions of a job in order to duplicate the set-up on the same or similar run at a later date. This may be done by drawing the existing conditions on the chart and filing it with the blueprint. The charts are assembled into a pad so that the pages may be torn out for filing.

By drawing four straight lines across the chart it is possible to solve problems in turning, drilling, boring, reaming, facing and milling. With this chart, it should in particular be possible to estimate production in pieces per hour. Some interesting examples accompany the chart.

Crobalt, Inc., Ann Arbor, Mich.

PROTECTIVE COATING

AeroED 1926 (Sept. 1943) . . .

12-pg, well illustrated bulletin, Ucilon summarizes the unusual properties of a new surface coating material that stands up under most corrosive service conditions.

The new coating is formulated with new and improved synthetic resins and produces tough, flexible coatings that are resistant to organic and inorganic acids, alkalies, salts, alcohol, gasoline, oils, greases and moisture. It also has excellent dielectric strength and can be readily applied to wood, metal, concrete and other surfaces by brushing, spraying or dipping. The booklet illustrates many essential uses and suggests others where corrosion is a costly problem or where the coating can be used in place of more critical materials.

•

Actual war uses are still on the secret list, but aircraft designers and constructors can deduce their only likely applications from a study of the above characteristics.

United Chromium, Inc., 51 E. 42nd St., New York, N. Y.

METAL CLEANING HANDBOOK

AeroED 1927 (Sept. 1943) . . .

72-pg, illustrated manual under the above title describes an organized process of selecting cleaning materials, methods of use and types of washing equipment adapted to cleaning various kinds and shapes of metal articles.

The first half of the "Metal Cleaning Handbook" is devoted to cleaning materials and the factors governing the selection of such compounds. The four main classes of cleaning materials, Solvent Cleaners, Petroleum Spirit Cleaning, Alkaline Cleaners, and Emulsifiable Cleaners are discussed separately. Under each is indicated the kinds of metals and articles for which it is best suited, its major uses and its disadvantages.

The second section of the manual constitutes a complete treatise on the modern metal washing machine. It discusses all types, from simple washing dip tanks to fully automatic, continuous conveyor machines for washing, rinsing, drying, cooling and pickling operations. These machines, besides being described in the text, are also pictured in blueprint form. Also provided are several tables, charts and pictures of pertinent material. The balance of the handbook discusses related metal processing operations such as drawing, lubricating, burnishing, and anti-rusting.

•

In the section on alkaline cleaners we note in particular the number of operations fully covered such as cleaning after drawing and stamping; cleaning die cast parts; after

salt bath annealing, etc. The 72-pg booklet is much more than sales literature. It is a complete engineering text on metal cleaning.

It is remarkable how the modern cleaning machine has developed with its tunnel, washing sections, strainer section, rinser section, conveyor, loading devices, and the like. These machines are also divisible by size of part. Some taking care of quite small parts, other larger elements such as parts of an airplane engine, still larger ones a whole frame or chassis. The book will be invaluable in many industries including the aircraft industry.

Magnus Chemical Co., Garwood, N. J.

TAP GRINDERS

AeroED 1928 (Sept. 1943) . . .

An 8 pg illustrated catalogue (Bulletin No. 5) covering the operation and new construction features of two tap grinders.

Both machines will sharpen the chamfer on taps from No. 0 to 2 in with 2, 3, 4, 5, 6, 8, or 10 flutes either right- or left-handed. One grinder has a capacity for taps up to 6 in long and the other for taps up to 14 in long. The catalogue covers such new standard and optional features and attachments as the new locating arm and finger which keeps the locating finger always on the centerline of the grinding wheel, an attachment for grinding quantities of 2-flute taps, special collet chuck spindles for holding round shanks up to 1½ in, and special OD tailstock for multiple-fluted drills and reamers.

•

It will no longer be necessary to discard taps, with threads intact, for lack of a rapid low cost method for accurate chamfer sharpening because these grinders provide the method.

Edward Blake Co., 634 Commonwealth Ave., Newton Centre, Mass.

BREATHER-FILTERS

AeroED 1929 (Sept. 1943) . . .

4-pg catalogue describes a number of breather-filters used for the protection of crankcases, presses and a variety of other machines.

In these filters, any dust or foreign matter in the air impinges on a series of oil-wetted wire baffles, thus preventing dust from entering the vented case. At the same time these baffles act as an efficient flame and spark arrester. All-weather hoods are supplied for outside installation, and bronze construction is available if the breather is to be subjected to corrosive fumes or used in marine applications. The advantages of these filters include a large surface area due to cylindrical design, vibration-proof filter media, quick cleaning and an approved flame arrester.

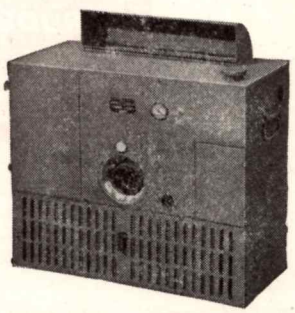
Special "Oil Bath Type" breather-filters are recommended when installation is on equipment located in foundries, on road building jobs and in other places where dust concentration is unusually high. In this type, the filter media is enclosed in a bowl, the bottom of which is filled with oil. Outside air must first pass through the oil, then through the filter media, be-

(*Continued on page* 339)

HUNTER UNIVERSAL GASOLINE HEATERS

have a hundred handy uses—heating, ventilating and providing automatic hot water supply in trailers, busses, trucks, field service shops, hospital stations, photo laboratories, mapping stations; for portable or permanent installation in barracks, storage buildings, radio and radar shelters. • Many other special applications that may include one of YOUR problems. • Write or wire for bulletin No. HB-3 or for a test under your specifications.

Typical Hunter unit at right has capacity of 20,000 to 40,000 B.t.u. per hour, with 400 C.f.m. air circulation. Others from 10,000 to 60,000 B.t.u. capacity. Also assemblies for duct installation . . . Automatic water heating units.



HUNTER AND COMPANY

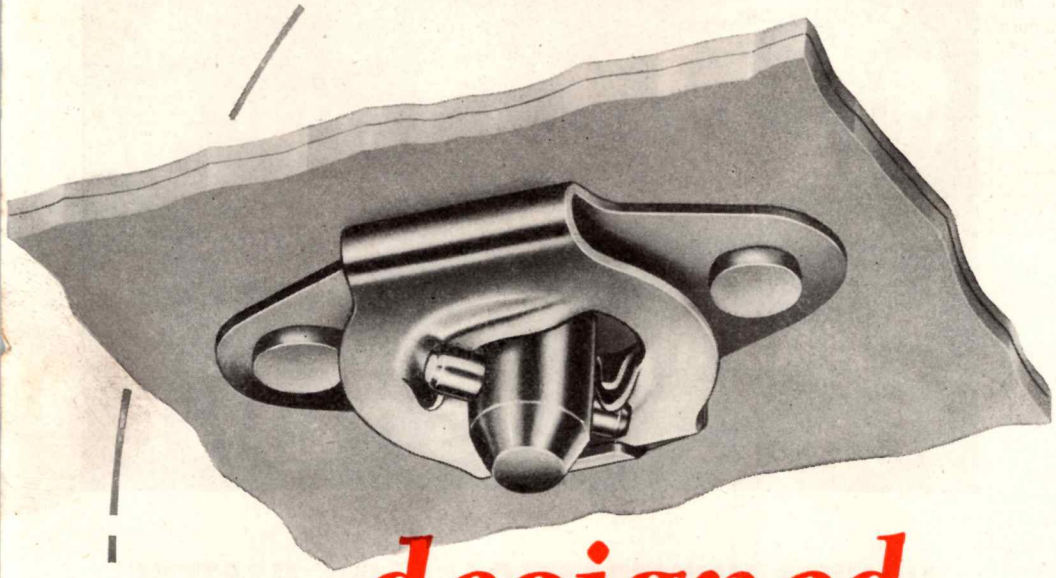
Aircraft Equipment

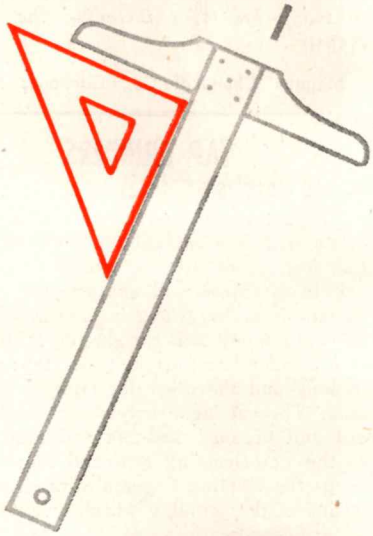
1554 E. 17th St.

CLEVELAND • OHIO

SHAKEPROOF

COWL FASTENERS





designed for all... 3

1 PRODUCTION

Designed to speed assembly! Only 3 parts—spring unit, stud, and cross pin. Just one special tool needed. Shakeproof Cowl Fasteners assure fast, easy installation.

2 PERFORMANCE

Designed to give fighting aircraft the optimum in efficiency! Shakeproof Cowl Fasteners provide positive locking, exceptional endurance, and embody many important extra safety features.

ARMY E NAVY

3 SERVICE

Designed for quick-action locking, Shakeproof Cowl Fasteners assure fast field maintenance and repair. Easy application speeds replacement of damaged parts and simplifies salvage work.

AVIATION DIVISION

SHAKEPROOF inc.

"Fastening Headquarters"

Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS

2501 North Keeler Avenue, Chicago 39, Illinois

Plants at Chicago and Elgin, Illinois. In Canada: Canada Illinois Tool, Ltd., Toronto, Canada

LOS ANGELES OFFICE
5670 Wilshire Blvd.,
Los Angeles 36, Cal.

DETROIT OFFICE
2895 E. Grand Blvd.,
Detroit 2, Mich.

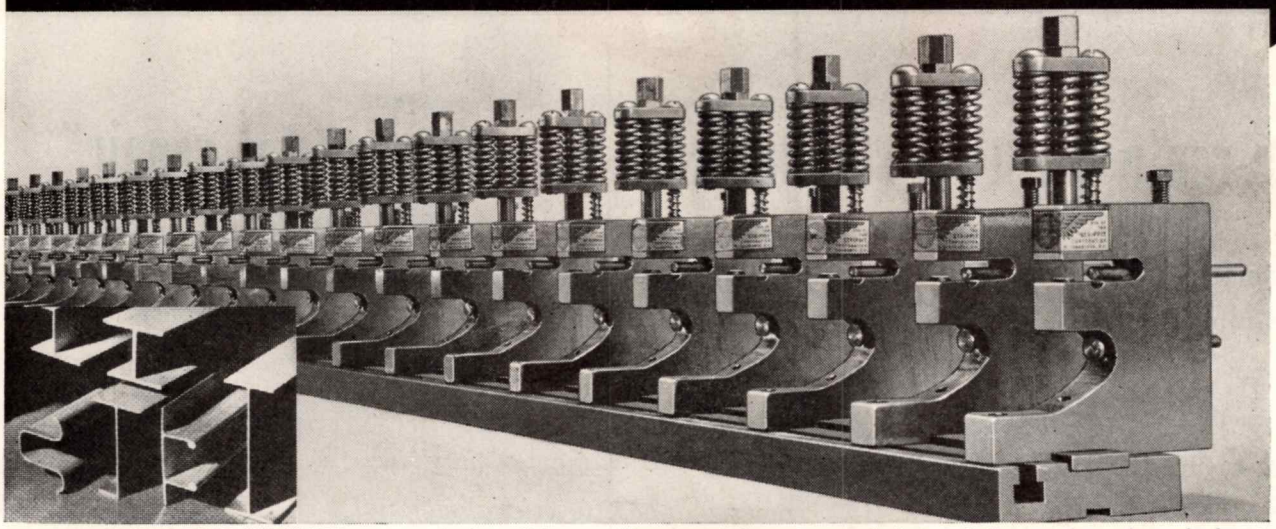
FOR CANADIAN AIRCRAFT
Teleflex Limited,
56 Bloor St. W., Toronto

FOR CANADIAN INDUSTRY
Canada Illinois Tools, Ltd.
177 Front St. E., Toronto

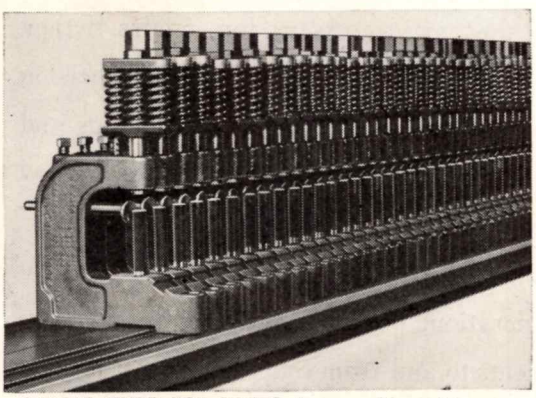
DESIGNED SPECIALLY FOR

Speeding-up Aircraft Production

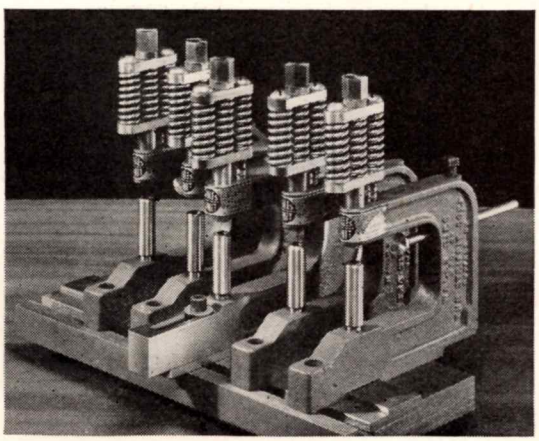
WALES HOLE PUNCHING UNITS



WALES TYPE "E" UNITS on press brake rail for punching extruded sections and shapes similar to those shown in insert.



WALES TYPE "C" UNITS for punching stringers, sheets and angles.



WALES TYPE "CA" UNITS (shown in center of 4 Type "C" Units) which provide front to back adjustment for scattered hole patterns.

All leading aircraft manufacturers have standardized on Wales Hole Punching Units. The reasons are as unlimited as the number of patterns provided by these units.

Among the major time-saving features of these patented units putting more planes in the air faster are:

1. **Aligning of punch and die is eliminated.**
2. **Punch and die held in perfect alignment by holder.**
3. **Nothing is attached to press ram.**
4. **Each unit is independent and self-contained with punch, die, stripping assembly and holder.**
5. **Setting and resetting patterns only require sliding each unit into position.**
6. **Unlimited straight line or staggered patterns with the same group of units.**

All the exclusive developments built into Wales Units are in keeping with the progressive policy — "There's Always Something New in the Wales Line."

Keep posted by writing for Bulletin "C" today.

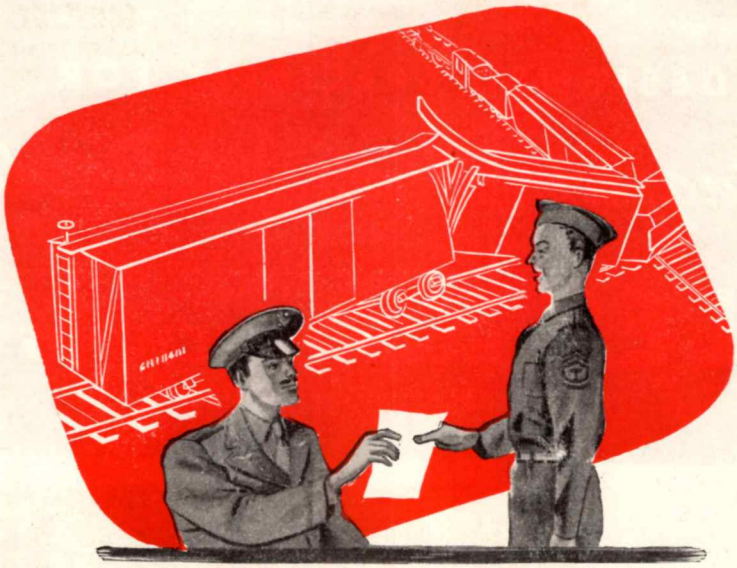
WALES-STRIPPIT CORPORATION

347 Payne Avenue

NORTH TONAWANDA, NEW YORK

GEORGE F. WALES, *President*

Specialists in Punching and Notching Equipment.



"Re-route damaged stabilizers to Aero Services for repair"

A grinding crash...a speeding freight train wrecked! In those splintered cars below, heavy bomber stabilizers jammed together. A dismal looking mass. No time to waste. Out West the Air Forces need those spare parts. "RE-ROUTE DAMAGED STABILIZERS TO AERO SERVICES FOR REPAIR!" comes the order from the Army Air Force Command. Not back to the factory to disrupt the already overcrowded production lines. We receive those stabilizers, repair them good as new, rush them on to the Air Forces Depot.

That's our specialty...rebuilding damaged aircraft parts and surfaces. A specialty more highly developed here than elsewhere in this country. The tough jobs. Those the aircraft maintenance depots aren't equipped to handle. Everything from ground-looped trainer wings to flak-torn surfaces and damaged floats. From the Solomons and the Aleutians. Into them we breathe new life, send them back to war once more against our enemies. *Every damaged aircraft returned to battle equals a new one fresh from the assembly line. Time saved. Money saved. Tons of critical material saved!*

Our facilities are extensive and complete. We even make the parts necessary for repairs if they are not obtainable from the manufacturer. Precision work is assured by converted production jigs and fixtures and a personnel with the skill developed only by years of broad experience.

Perfection is our motto. It's expected of us. Economical operation, too. That's why salvage pays, why shipments to and from our plant increase each passing day. Army and Navy Air Forces count on Aero Services to return more aircraft to service.

Aero Services INC.

J GORDON HUSSEY, PRESIDENT

• RECONSTRUCTORS OF DAMAGED AIRCRAFT •
CONTRACTORS TO ARMY, NAVY AIR FORCES
METROPOLITAN AIRPORT • VAN NUYS • CALIF.

(*Continued from page* 335)

fore entering the crankcase or housing. The oil forms an air-tight seal against the entrance of outside dust and the filter media is an additional protection. Where installed on crankcases designed for positive ventilation, the air velocity through the breather-filter causes an automatic oil washing action which continually cleans the filter. Also included in the catalogue is a chart of the types, sizes, dimensions and weights of the standard filters. The vent sizes range from ⅜ to 3½ in and the shipping weights from ½ lb to 16 lb.

•

The Air-Maze Breather-Filters are giving excellent service in such applications as in a 9-cylinder gas engine, in liquid storage tanks, in the venting of crankcase of an engine and compressor installation, and in the protected venting of a hydraulic press.

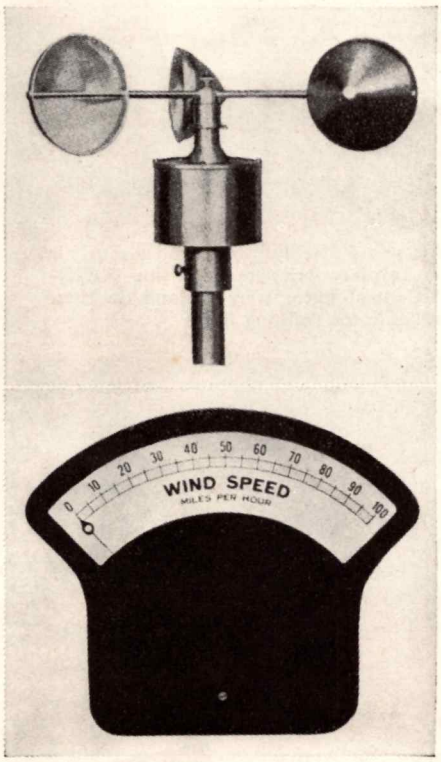
Air-Maze Corp., 5200 Harvard Avenue, Cleveland, Ohio

PORTABLE AIRPORT ANEMOMETER

AeroED 1930 (Sept. 1943) . . .

2-p leaflet describing a portable anemometer of the electric type which can be used to make wind speed analysis at any location on an airport.

The unit consists of a voltmeter indicator mounted in the handle of a conventional



anemometer generator which produces a straight line non-fluctuating voltage over the entire scale range. The cup wheel spindle is of hard drawn naval bronze and is supported on grease-seal ball bearings. These assume both radial and thrust loads and keep the radial load close to the horizontal axis of the cup wheel. The 13-in indicator scale is run for 200 hours before final calibration at speeds equivalent to 100 mph. Other units such as knots or meters per second can be furnished on the scale and for permanent records a strip-chart recorder can be used in place of the indicator. The field magnet is fully aged, and other fine features are included in the design.

•

Thanks to careful wind tunnel experimentation, the rate of rotation is directly proportional to the linear speed of the air, and safe wind exposure is 150 mph. Starting wind is only 2.2 mph. The instrument is doing splendid work under the severest climatic condition, and in particular is used over the Pan American Airways network.

Electric Speed Indicator Co., Cleveland, Ohio

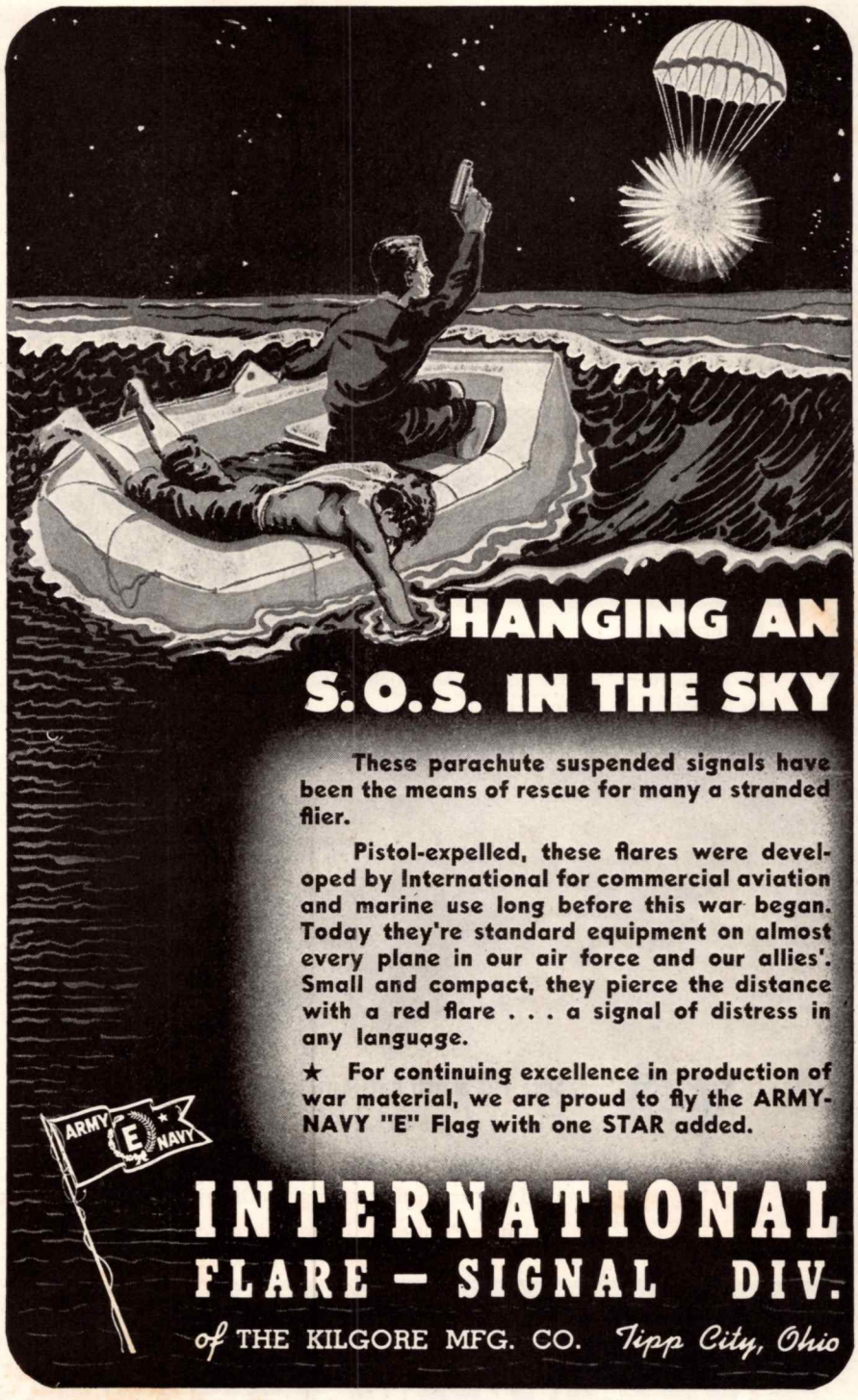
CONVEYORS AND PNEUMATIC TUBES

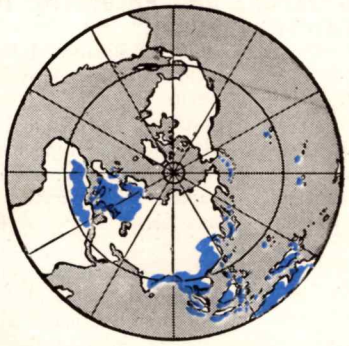
AeroED 1931 (Sept. 1943) . . .

An interesting series of illustrated booklets on overhead conveyors, roller gravity conveyors and pneumatic tubes.

A variety of conveyors and dispatch tubes is fully described. A gravity type conveyor has been devised to meet war needs—one in particular, adapted for conveying shells, in which the rows are flush with the top of the guardrails making it particularly easy to roll shells on and off the conveyor. Drawings show a typical layout of the dispatch tube system used by many airplane makers with a central mailing room connected to such departments as Salvage, Shipping, General Receiving, etc., etc.

(*Continued on page* 341)

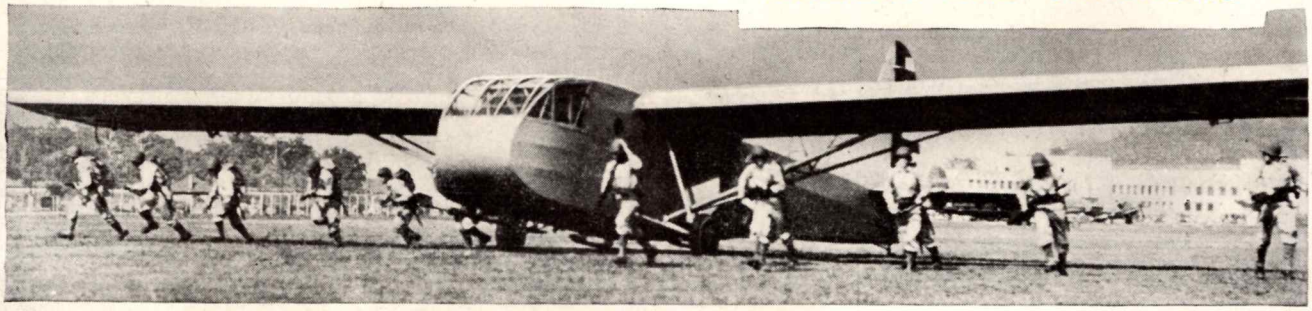




Serving over EVERY FRONT

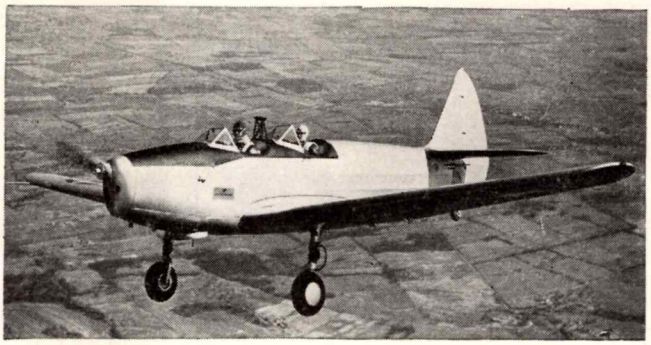
and behind the lines for Victory!

Hyland-equipped aircraft of many leading manufacturers are now on active duty in the combat areas, shown on map, and at training fields here and abroad. This is the first in a series of advertisements presenting Hyland-equipped **GLIDERS and TRAINERS**



TROOPS are shifted when and where they're needed by giant combat gliders such as this WACO, CG-4. Hyland control equipment helps to make them dependable in action . . .

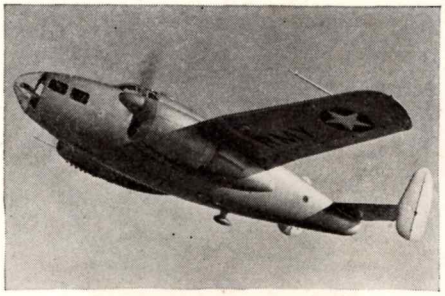
AND DEPENDABLE for training glider pilots in the basic principles of motorless flight, preparatory to actual combat maneuvers, are training gliders such as this Hyland-equipped AERONCA, TG-5 . . .



BUT BASIC training for pilots of engine powered aircraft is relegated to stable primary trainers like this FAIRCHILD "Cornell." Control fixtures by Hyland do their part in making it reliable for training flight . . .

ADVANCED TRAINING for bomber pilots is started in this typical twin-engine training plane, CESSNA, AT-17, equipped with Hyland rod ends and control fittings . . .

FURTHER ADVANCED gunnery training is made possible by twin-engined aircraft such as this FAIRCHILD "Gunner," fully equipped with bomb doors and gunners stations and Hyland control fittings, clamps, clips and eyebolts.

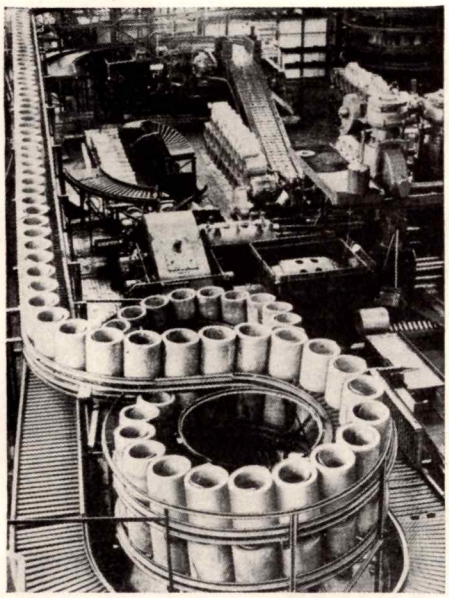


Hyland employees are proud of this flag. It displays the united loyalty of every worker.

Since 1928 aircraft parts have been our business . . . from the very first, when The Hyland Machine Company was organized to serve the Army Air Corps, we have specialized in aircraft control parts. You will find our manufacturing facilities and unusual service worth investigating. Phone, write or wire today for the new Hyland Catalog.

HYLAND MACHINE COMPANY

DAYTON, OHIO



(*Continued from page* 339)

3″ x 12″ tubes have been designed specially for carrying blueprints. Another type of installation allows the dispatch of small tools to workmen via pneumatic tube. Overhead conveyors save floor space and increase greatly the rapidity of flow of materials and tools and some conveyor systems eliminate entirely the hand-trucking within the plant. Set flush with the floor level, drag chain conveyors move dollies on which are assembled aircraft engines, fuselages, wings and even complete planes. Traveling at low speed, the conveyors bring vital parts of the plan trough sub-assemblies and converge at main assembly.

Other systems permit descent from one floor to another by gravity. Still another application is in engine parts. A Uniframe roller conveyor consists of rollers properly balanced in weight and dimensions, mounted between guard rails, and is light and quick of action. A good deal of engineering design has gone into these free ball bearing rollers which can be regular, differential or tapered and permit two-way 90 degree junction, 30 degree junction and the like. Portable conveyors may sometimes be handy. Interesting illustrations show cigarette cartons, etc. on these conveyors.

•

There is no doubt that there are enormous possibilities in these roller and pneumatic tube dispatch systems. They have proved themselves thoroughly with a number of aircraft plants such as Douglas, Glenn Martin, North American and others, and there is scarcely a large factory in which these systems cannot be adapted. It is even conceivable that these conveyors might be used in cargo handling at airports.

Lamson Corp., Syracuse, N. Y.

WARTIME REPORT ON LIGNUM-VITAE

AeroED 1932 (Sept. 1943) . . .

Booklet deals with lignum-vitae as a substitute for critical metals and plastics in mechanical and diversified industrial applications.

The material is a hard, resinous wood, with a density almost equal to iron, and weighs about 83 lb per cu ft, having a specific gravity of 1.3. Its modulus of rupture is 11,200 psi. Its great density and homogeneity make it capable of withstanding a working pressure of 2000 lb per sq in. The high resin content of the new material, which runs about 30% of its weight, consists of a natural gum which, combined with its pressure resisting quality, renders it admirably suited for mechanical purposes where the introduction of lubrication is not practicable. Being non-ferrous, the new material is rustless and water merely acts as a preservative and an added lubricant. It is non-contaminating, self-lubricating and resistant to mild acids and chemicals. The new material can be supplied in the form of logs, boards, squares, rods, cylinders, blocks, etc.

We had no idea of the almost innumerable applications of lignum-vitae which are possible in bearings, bushings, balls, mallets, guides, tools, turned wood parts in many industries. Rollers for airport doors and water rudders on aircraft pontoons are two applications that strike home.

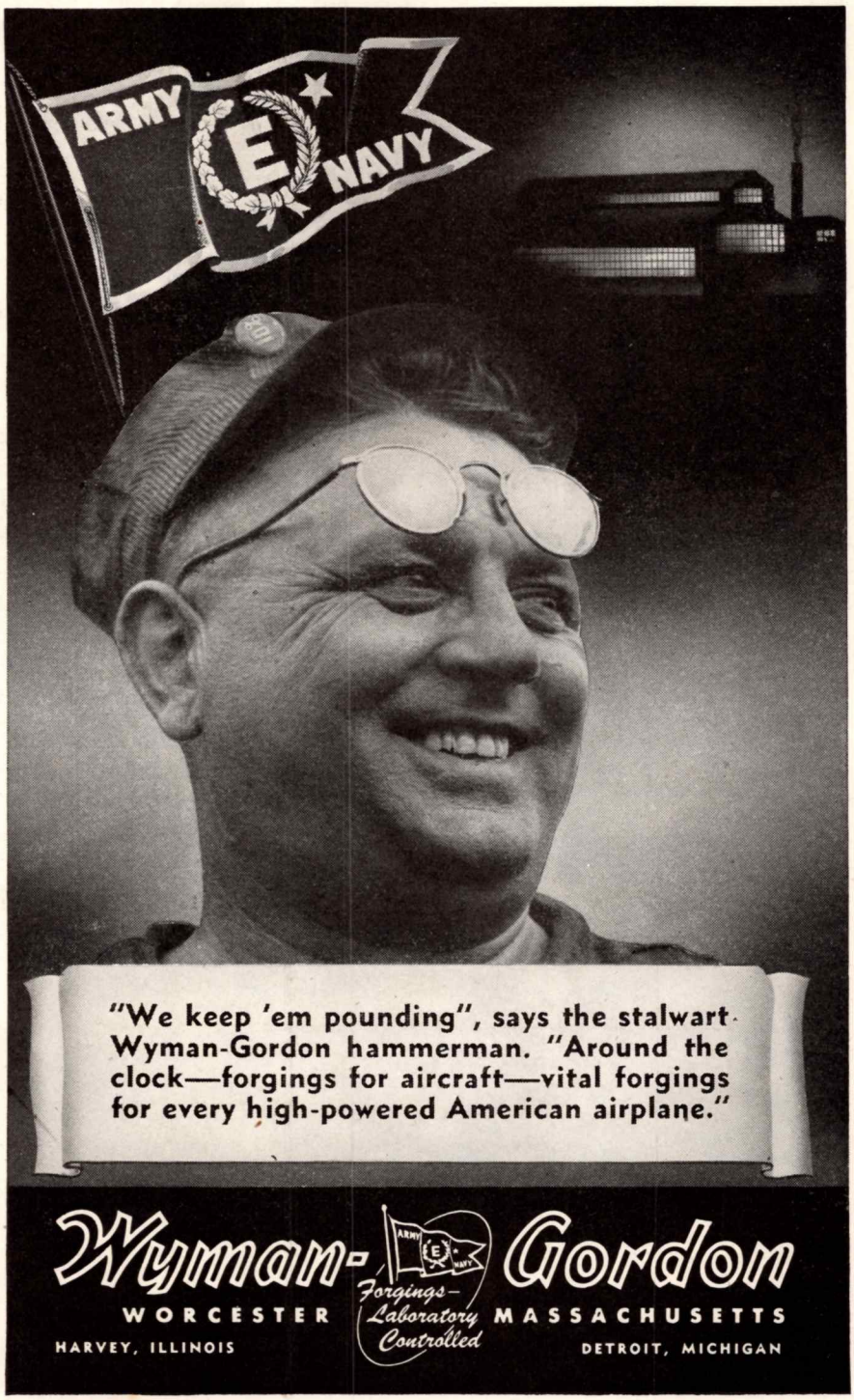
Lignum-Vitae Products Corp., 96-100 Boyd Ave., Jersey City, N. J.

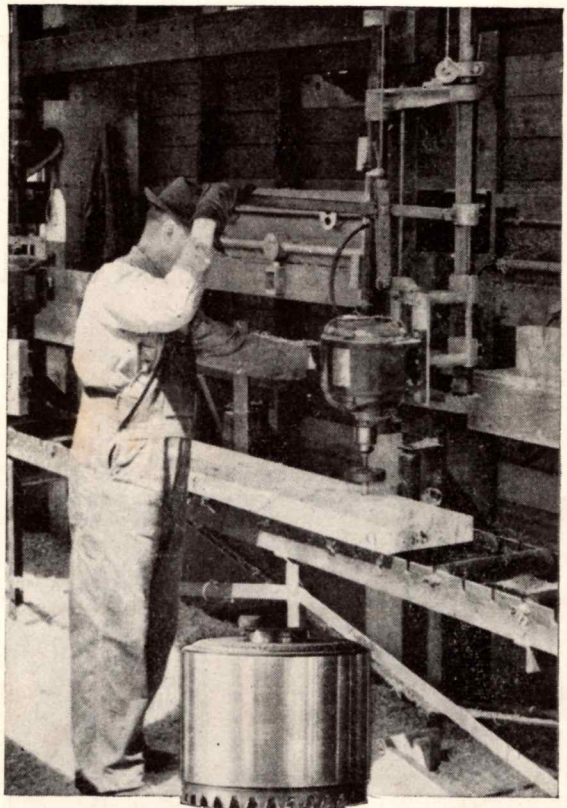
AUTOMATIC MACHINE TOOL CONTROL

AeroED 1933 (Sept. 1943) . . .

16-p illustrated folder "What is Duplimatic and How Does It Work?" shows a sectional view of an automatic machine tool control and explains its operation.

(*Continued on page* 343)





SOUND ENGINEERING ADVICE

✓ *Design* in TIMBER

✓ *Specify* TECO CONNECTORS

✓ *Employ* a Teco Timber Fabricator

'Round the World—100,000 timber war and peacetime structures have been quickly and economically built with the TECO Timber Connector System of Construction—sponsored by the lumber industry since 1933.

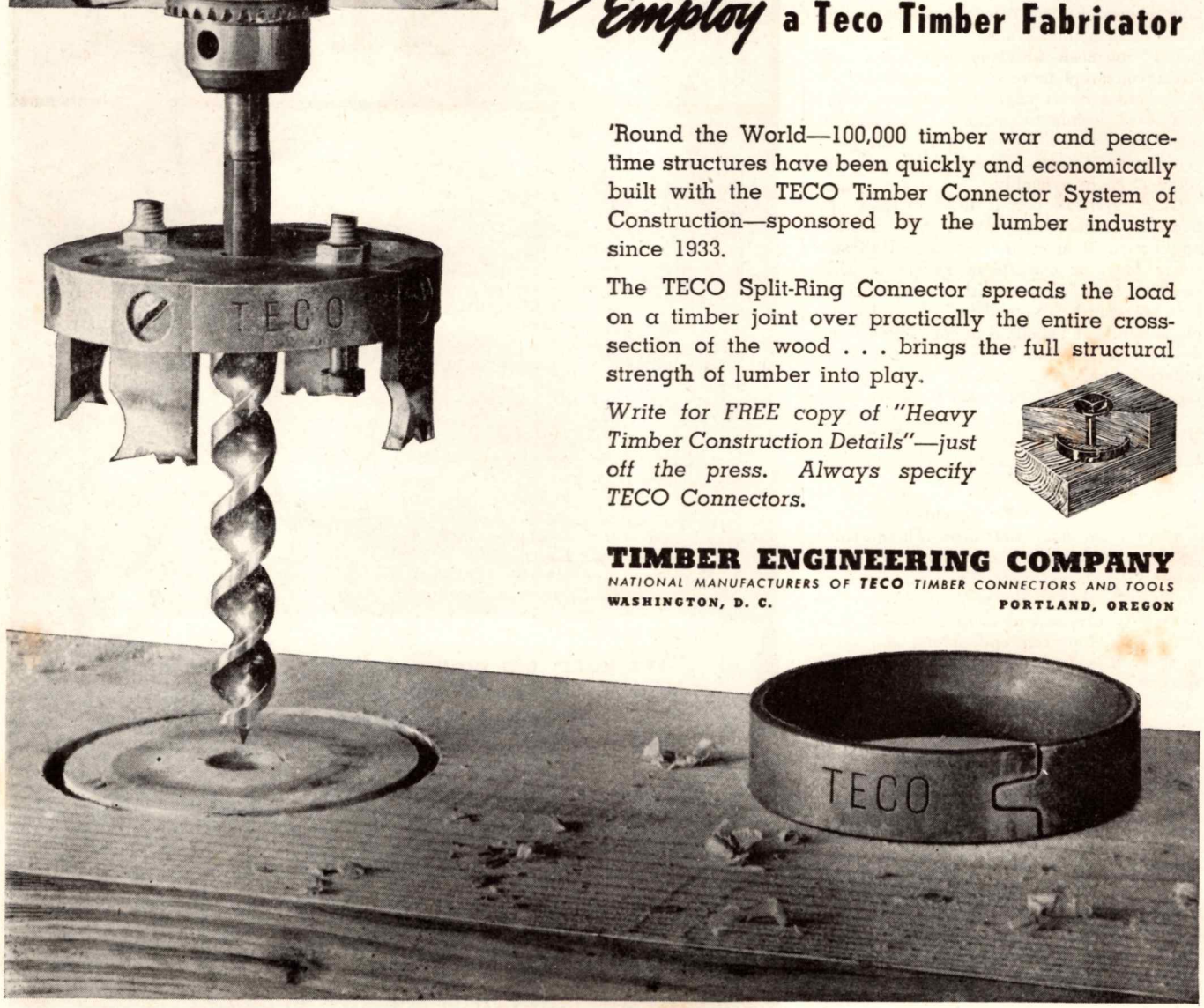
The TECO Split-Ring Connector spreads the load on a timber joint over practically the entire cross-section of the wood . . . brings the full structural strength of lumber into play.

Write for FREE copy of "Heavy Timber Construction Details"—just off the press. Always specify TECO Connectors.

TIMBER ENGINEERING COMPANY

NATIONAL MANUFACTURERS OF ***TECO*** *TIMBER CONNECTORS AND TOOLS*

WASHINGTON, D. C. **PORTLAND, OREGON**



(*Continued from page* 341)

The unit provides full automatic control to put intricate milling, turning, boring, shaping, die-sinking and similar operations on a high speed production basis by means of a simple method of converting variations in electrical impulses into hydraulic motion. Examples of the types of work that are being accomplished by the Duplimatic, together with illustrations of the machines used in various war production plants, are also shown.

•

It is fascinating to study the cut-away and finally understand the sequence of operations; how solenoids are connected with a contact point in the tracer head, how the solenoids when energized bring the hydraulic system into play, and how the hydraulic system actuates the work. The most intricate operations become possible and rapid.

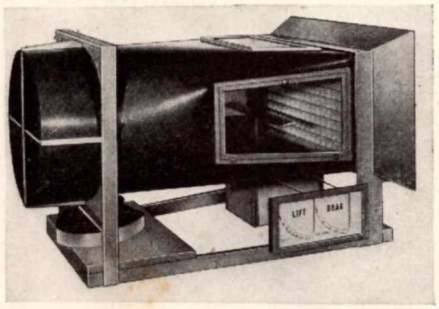
Detroit Universal Duplicator Co.,
749 E. Milwaukee Ave., Detroit, Mich.

WIND TUNNEL MANUAL

AeroED 1934 (Sept. 1943) . . .

Manual for the "Comet" wind tunnel. 36 pgs, illustrated with diagrams and charts.

Beginning with an outline of the various features of aeronautics which can be demonstrated by means of model planes and wind tunnel in the classroom, such as the value of



streamlining this treatise proceeds to detail not only what the tunnel can, but what it cannot be expected to do.

The bulk of the booklet is devoted to descriptions of actual experiments, with directions for reproducing them. These experiments which are furnished as samples of the usefulness of the tunnel, include: "Left and Drag of a Cambered Wing," "How the Wing Slot Works," "Airbrakes and Spoilers," and "The Effect of Airplane Controls."

Many helpful hints are provided, governing proper setup and procedure, the maximum dimensions of plane models to be used, how to compile lift and drag charts, and so forth.

•

This handbook presents a well organized discussion of the important experimental work that can be accomplished with model planes in a wind tunnel. As pointed out in the foreword, the experiments described "merely scratch the surface," and are offered in the belief that they will stimulate both student and teacher to devise other aerodynamic demonstrations.

Comet Model Airplane & Supply Co.,
129 W. 29th St., Chicago 16, Ill.

"ACCIDENT FACTS"

AeroED 1935 (Sept. 1943) . . .

The statistical yearbook of the National Safety Council, 100 pgs. Copiously illustrated with graphs, tables and charts.

This year the accident figures are geared to the war production effort in the nation's drive to conserve the manpower vital to victory. Analysis of accidents in all categories, with comparative figures, are here presented, covering Americans in every walk of life.

Manufacturers of military aircraft according to the report, were especially effective last year in protecting the safety of their workers. Of 31 war industries studied, the aircraft manufacturing industry was among the top five for 1942 in accident severity and among the top six in accident frequency. Workers in the aircraft manufacturing industry suffered only 9.53 disabling injuries per 1,000,000 man-hours worked, as compared with 14.85 for all 31 industries.

The severity of accidents in the military aircraft manufacturing industry was .61 days lost per 1000 man-hours, compared with an average of 1.49 for all 31 industries. Laundry, tobacco industry, printing and publishing and glass manufacture respectively had better severity records than the aircraft manufacturing industry. Tobacco, glass, steel, cement and automobile industries, in that order, had better frequency rates than the aircraft manufacturing industry.

•

Never more vital than at this time, the subject of safety is covered by this study in a most comprehensive and detailed manner. The interpretive comment is excellent throughout. As always, this annual report of the council will be found to include most of the statistical answers to all questions of safety.

National Safety Council,
20 North Wacker Drice, Chicago 6, Ill.

EMERGENCY CALL

THIS MAN'S NOT A DOCTOR — at least not an M.D. But he's called in on a vitally important case, trouble in the glue room of a wood-working plant with war contracts. In his hand is a viscometer, one of many instruments with which he diagnoses trouble.

Chances are this man's "know how," backed by 20 years' experience of his company and his own technical training, will straighten things out in a few minutes. Maybe, if it's more serious, the cure will have to come from Laucks laboratories. But — he'll get results.

This is just another service by Laucks staff of glue men, chemists and engineers, who know glue from inside out, who see that *Laucks glues do more than merely meet the specifications.*

Take advantage of this "bonus" . . . Laucks glue service . . . get your supplies and counsel from the world's largest makers of water-resistant and waterproof glues.

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LAUCKS SYNTHETIC RESIN AIRCRAFT GLUES
MEET GOVERNMENT SPECIFICATIONS IN THE AIRCRAFT INDUSTRY

AIRCRAFT PRODUCTION *is flying high* WITH SKILSAW TOOLS!

EVERY MAN COUNTS FOR MORE USING SKILSAW TOOLS!

SKILSAW BELT SANDERS—For faster, finer surfacing and sanding in wood pattern shops and all finishing on metals, wood, plastics, compositions.

● Look in the plants that are building more bombers, that are producing fighters quicker and rushing trainers off the lines faster. That's where you'll find SKILSAW TOOLS at work... speeding up all drilling, sawing, sanding and grinding...boosting production on countless operations.

Here's the reason: SKILSAW TOOLS are light, compact, powerful. They do more jobs . . . do them faster...and stand up longer on toughest 3-shift schedules. Ask your distributor to demonstrate SKILSAW TOOLS in your plant *now!*

SKILSAW, INC., 5047 Elston Ave., Chicago

New York • Boston • Buffalo • Philadelphia • Cleveland • Detroit
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SKILSAW DISC SANDERS—Speed up all sanding, filing, metal cleaning, grinding and polishing on flat or curved surfaces of wood, plastics, metals.

SKILSAW DRILLS—Light, compact, powerful . . . a size and type for every job from fastest production drilling to heaviest boring and reaming.

SKILSAWS—For faster, easier, better sawing on maintenance and construction, crating and uncrating, for pocket cuts in metal, plastics or wood.

SKILSAW PORTABLE ELECTRIC TOOLS

★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

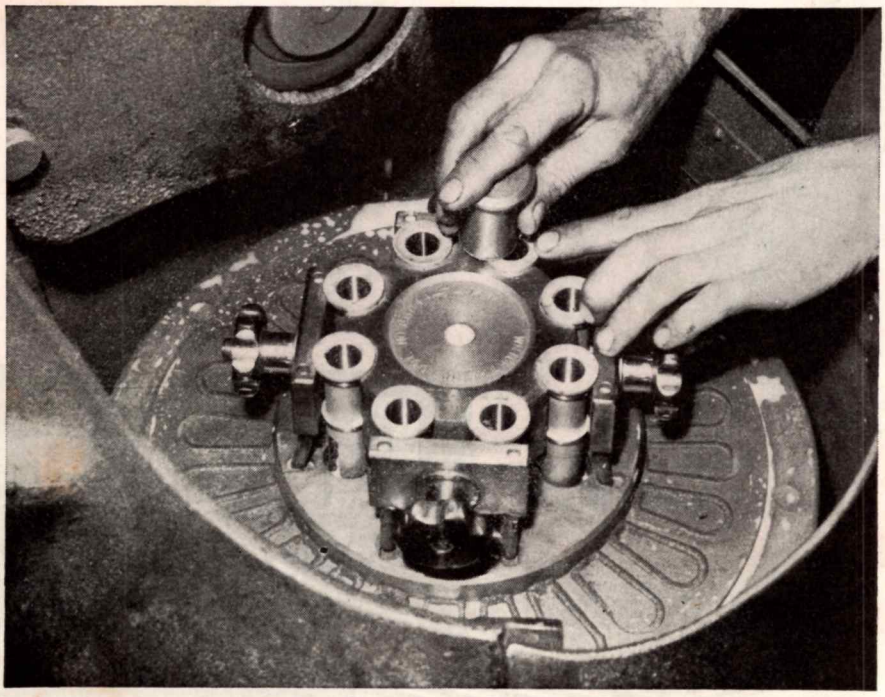
Fixture Permits Simultaneous Grinding of Eight Tappet Guides

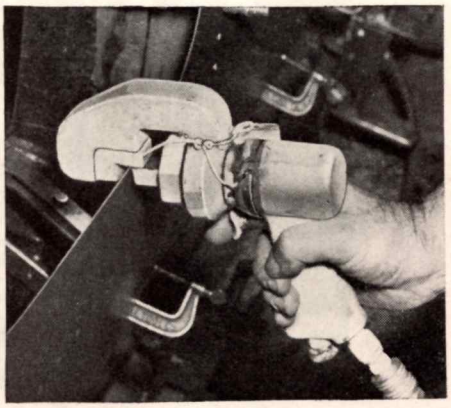
By means of a new fixture developed by Republic Aircraft engineers, at Detroit, tappet guide heads, formerly ground one at a time, are now being ground in sets of eight.

The eight tappet guides are mounted in an octagonal fixture, each guide fitting into a seat and held in place by a clamp operated by a hand screw. The upper edge of the fixture is beveled to fit closely under the head of the tappet guides, leaving the top faces exposed to the grinding wheel.

The fixture is positioned on the magnetic table of a rotary grinder. It is made of ordinary tool steel and was built in the company's tool room. Designs are being worked out for an improved model that will handle twelve tappet guides at one operation, with no increase in operating time.

Republic device for simultaneous grinding of eight tappet guides instead of one at a time, as formerly. Made of ordinary tool steel, this mechanism operates on magnetic table of a rotary grinder





Pneumatic tool attached to rivet gun enables unskilled workers to crimp aircraft skin efficiently. This is a Vega idea

Pneumatic Tool Makes Crimping Easy

Under ordinary circumstances it is possible to crimp metal edges with commercial machines designed especially for this purpose. However, mass production methods used in the construction of the Vega *Ventura* prohibits "precrimping." It is necessary, therefore, to perform this operation after the skin has been attached to the airplane.

Formerly the crimping operation was done with a block of wood with a slot at one end. By use of this crude tool, hand crimping was accomplished, but the process was a slow tedious one.

To provide a tool which would enable unskilled workers, particularly women, to perform this operation easily and efficiently, a pneumatic crimping tool was designed by the Tool Engineering Department.

Attached to a rivet gun, the tool produces a uniform continuous and rapid crimping action. This action leaves the form metal neat and clean and allows better scaling of joints than has been previously obtainable.

New Tool Kit for Faster Work

A new type of kit for assembly tools, embodying features of visibility and convenience, has been developed at the plant of Murray Corporation of America. Furthermore, by making one kit do the work of two and sometimes three, the company has eliminated a bottleneck in assembly tools.

Known as an "inside-out" portable kit, it consists of an A-shaped sheet metal stand with perforations on all sides, into which clips are placed to hold the tools necessary for any particular assembly operation. Thus the kit becomes, in effect, a regular tool

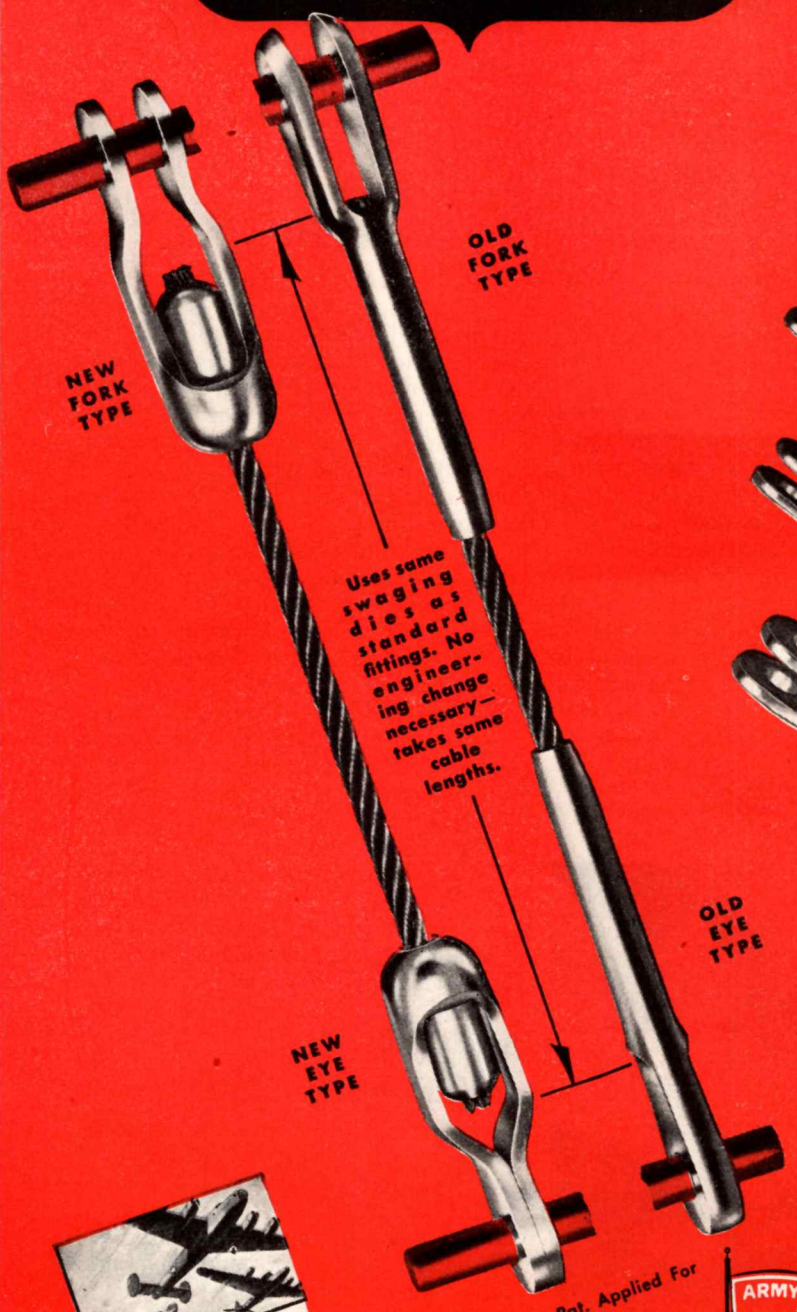
(*Continued on page* 347)

POULSEN & NARDON

SOCKETYPE Cable Terminals

Simplify swaging and double assembly production. Approved as interchangeable with B & C types of present standard AN & NAF swaged cable terminals.

PN



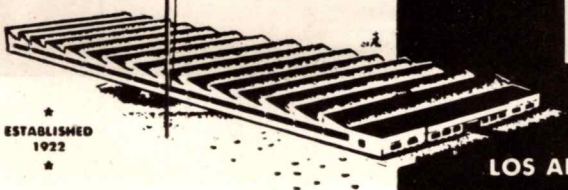
Pat. Applied For

CHOICE OF CABLE SIZES

Other cable sizes and types available on special order.

Send for new specification sheet and folder on your company letterhead.

ARMY E NAVY



★ ESTABLISHED 1922 ★

POULSEN & NARDON, INC.

LOS ANGELES 11, CALIFORNIA

Production Short Cuts

AWARD for SEPTEMBER

AERO DIGEST'S $100 WAR BOND goes to

C. S. McDONALD

Fairchild Engine and Airplane Corp. employee

For designing a new tool used in forming rudder trailing-edge sections

EACH MONTH AERO DIGEST awards a $100 War Bond to the person or persons whose production short cut, described in these columns in the previous issue, is considered most valuable by the judges. If more than one person is responsible for the winning short cut, the award will be divided equally. The decision of the judges is final.

THE JUDGES are: Dr. Alexander Klemin, Consulting Editor, AERO DIGEST, Chairman; Alvin E. Dodd, pres., American Management Assn.; Frank J. Oliver, American Society of Tool Engineers; Col. James L. Walsh, War Production Committee, American Society of Mechanical Engineers, R. F. Gagg, representing Society of Automotive Engineers.

ROLL OF RECENT WINNERS

Richard S. Reynolds, (right), president of Reynolds Metal Co., presents AERO DIGEST'S $100 War Bond to Arthur Chism, winner of the August award.

Walter Hirtreiter
Curtiss-Wright Corp.

Robert E. Christy
Ryan Aeronautical Co.

Victor Sundquist
Douglas Aircraft Co.

Walter A. McGarvin
Douglas Aircraft Co.

John R. Weeks
Westinghouse Elec. & Mfg. Co.

Ralph Hawn and Paul Weaver
Curtiss-Wright Corp.

Harry F. Kniesche
Glenn L. Martin Co.

Albert Heinss
General Motors Corp.

Edmund Klonowski, Robert C. Miller, Jr. and Vernon King
Bell Aircraft Corp.

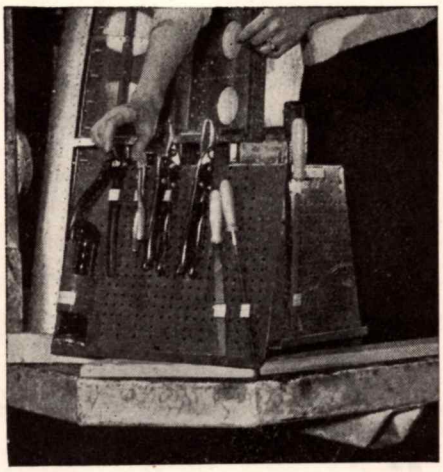
Earl D. Rothrock
Vega Aircraft Corp.

C. R. Stevenson, A. H. Haberstump and V. J. Lovett
Murray Corporation of America

V. L. Greth
Westinghouse Elec. & Mfg. Co.

Dr. R. C. Burt
Lockheed Aircraft Corp.

ASK YOUR COMPANY to send in a description of your production short cut, attesting to its actual adoption, together with a photograph or drawing. See that complete details are submitted.



Portable kit used by Murray Body consisting of A-shaped metal stand perforated on all sides to hold clips supporting necessary tools for given job

(*Continued from page* 345)

kit turned inside out, with all tools visible.

Credit for the innovation goes to a number of persons, Mike Budnar having made the most important of the suggestions. Hubert V. Backus, process methods engineer, developed the inside-out tool kit in the form in which it is now used.

Coincident with the adoption of the new tool kit, Murray changed a time-honored shop practice, in the interest of tool conservation. On assembly operations, separate tool kits had formerly been issued for each shift, requiring two or three identical sets of tools for each station and for each set of operations. Each crew, upon quitting work, locked up its tools and the next crew used its own set.

Under the new system, a kit is placed at each station, and left there for all shifts. Admittedly this has increased the opportunity for thefts of such standard tools as pliers, shears, and drills, but experience has demonstrated that even though there may be some loss through theft, far fewer tools are required to keep the assembly stations in operation.

Bubble Bath for Iron Filings Test

A new set-up has been devised at General Electric's Schenectady plant, whereby the clumsy oil can may be eliminated in testing for cracks and otherwise undetectable flaws in magnetic materials by the established method, according to which the piece is placed in a magnetic field, magnetic powder is spread over the surface, and observations are made of concentrations of particles, revealing the cracks or flaws.

(*Continued on page* 351)

Working for DEAR LIFE

Rrrr-up . . . Rrr-up . . . Rrrr-up . . rup . . rup . . up . . Minute after minute . . . hour after hour . . . day after day . . . this staccato machine-chatter goes on, down the long lines of intense operators in the Switlik parachute factories. ☆ ☆ ☆ Sewing for dear life, indeed, that the precious lives of those few, to whom so many owe so much, shall have that vital protection against the hazards of combat flying. ☆ ☆ ☆ Thru the genius of Switlik engineers, Switlik methods of production have been developed that are daily establishing records in making more chutes and faster deliveries for protecting those lives which are speeding up our march to Victory.*

SWITLIK
SAFE-T-CHUTES

*Two one-hundred-dollar bonds put a paratrooper back of the Axis!

Do your best for the 3rd War Loan drive.

SWITLIK PARACHUTE COMPANY
Trenton, New Jersey

The Plywood Airplane is a *TEGO-BONDED* Airplane

THE COMPLETE RESIN BONDING LINE AT WORK

THE modern plywood plane, such as the De Havilland Mosquito pictured here, resulted directly from the introduction of TEGO Resin Film in 1935. Use of this pioneer synthetic resin adhesive first enabled woodworkers to make weather-proof, fungus-proof, boil-proof aircraft plywood. TEGO also solved the problem of producing highest quality aircraft plywood in large quantities quickly.

Today, as for many years past, TEGO-bonded plywood is the accepted standard for aeronautical plywood meeting the rigid requirements of the U. S. Army and Navy Specifications. No other resin adhesive can match the long record of outstanding performance which TEGO has demonstrated. In the construction of practically every plywood plane TEGO-bonded plywood is widely employed.

Tego Resin Film

TEGO Resin Film, a phenol formaldehyde type resin in sheet form for hot pressing, has been, since its introduction in 1935, the standard for highest quality, completely waterproof, hardwood plywood.

Its advantages include unquestioned durability and strength of bond, uniformity of spread, cleanliness and precision of operation, absence of glue water, freedom from surface penetration, and speed of output.

Today, TEGO Resin Film can add to these advantages a length, diversity and severity of service unapproached by any other comparable plywood adhesive.

The Uformites

UFORMITE 430 is a urea formaldehyde resin adhesive in liquid form. It has extended the advantages of resin adhesives to lower cost fields and is currently finding widespread use in vital war and essential civilian applications.

UFORMITE 500 is a similar resin supplied as a dry, water dispersible, powder. UFORMITE 430 and 500 are used for both hot and cold-setting work.

UFORMITE CB-551, a cold bonding ready-to-use urea formaldehyde resin with catalyst, is easy to use, gives bonds far superior to older cold-setting glues. Complies fully with AN-G-8, 52-G-11 and other aircraft and marine specifications.

The Amberlites

The AMBERLITES are phenol formaldehyde type resin adhesives, supplied in powder or liquid form. Each AMBERLITE is designed specifically for use in hot pressing several types of plywood.

AMBERLITE PR-51 — DFPA approved adhesive, in dry powder form, for use in EXT plywood.

AMBERLITE PR-14 — This resin adhesive, supplied in powder form, is widely employed in the manufacture of aeronautical and marine plywood, and for molded, "rubber bag," plywood.

AMBERLITE PR-50 — A liquid type adhesive for impregnating, compregnating plywood.

THE RESINOUS PRODUCTS & CHEMICAL COMPANY

WASHINGTON SQUARE, PHILADELPHIA, PA.

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For the WAR PROGRAM

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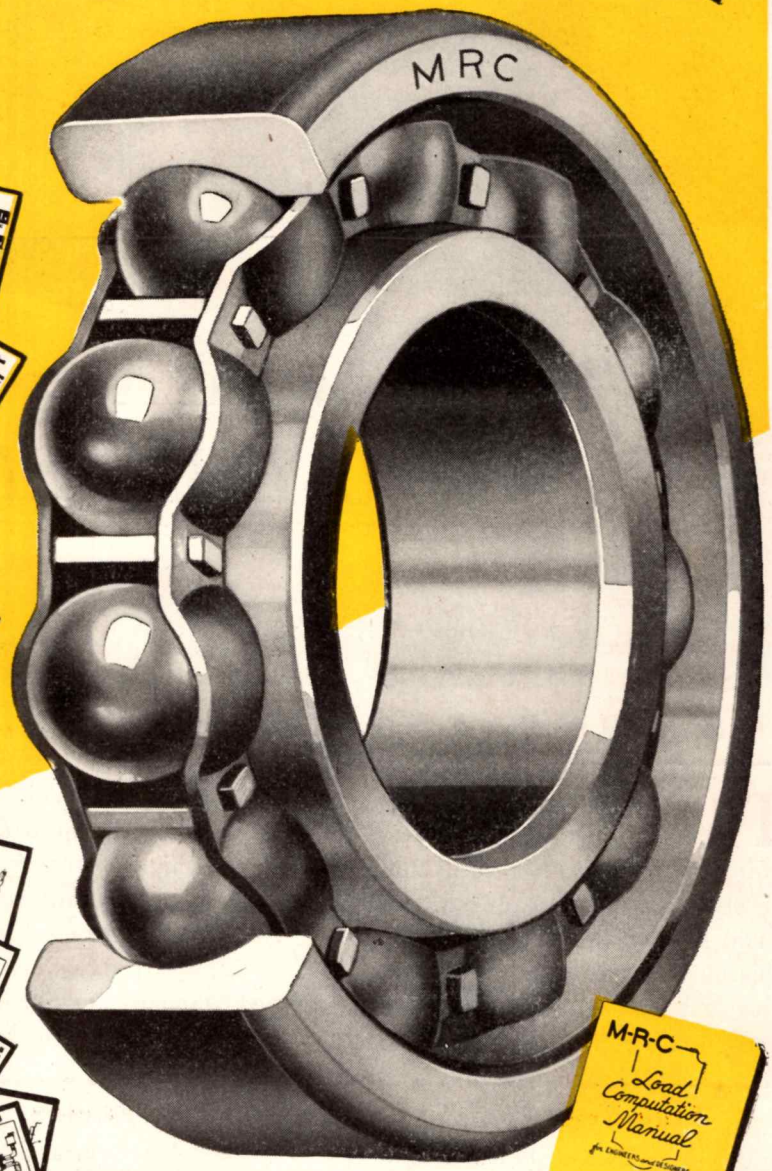

M-R-C LOAD COMPUTATION MANUAL is a 68-page booklet of methods for calculating loads on bearings. Sent free to mechanical engineers and draftsmen — send letter on your company stationery.

M-R-C BALL BEARINGS

Leadership M-R-C Strom SRB Gurney Ball Bearings

MARLIN-ROCKWELL CORPORATION

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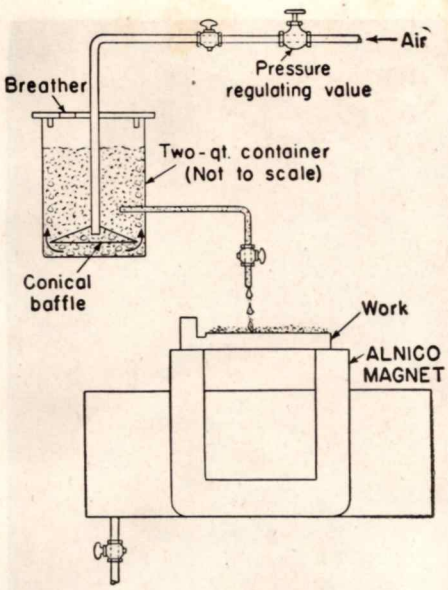


"Bubble bath" at General Electric replaces clumsy kerosene oil can used in the conventional method for detecting flaws in magnetic materials

PRODUCTION SHORT CUTS

(*Continued from page* 347)

The conventional way of applying the test calls for a suspension of finely divided particles of magnetic iron oxide (magnetite) in kerosene or a similar medium. The particles tend to settle to the bottom, so that it has usually been necessary to keep the liquid in an oil can and to "shake well before using."

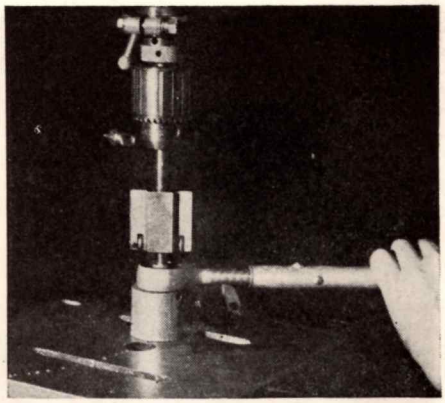
With the new set-up, in cases where many small pieces of machined alloy steel must be checked, the clumsy and time-wasting oil can has been eliminated. J. B. Bobowski, a methods man, has perfected a "bubble bath" for the agitation of the liquid, consisting of a covered tank to hold the solution, an outlet tube, and a supply line to carry low-pressure air to the bottom of the tank, where the iron oxide would settle.

A conical baffle was found to help materially by dispersing the air stream over more area of the bottom of the tank, thereby maintaining more uniform consistency of the liquid. Plugging of the outlet tube while not in use is prevented by placing it a few inches above the bottom of the tank. Glass or a nonmagnetic metal is used in constructing the agitator.

Double Spinner Cuts Bearing Production Time 60%

A Fairchild machine shop worker, F. M. Carpenter, has devised a new method for staking ball bearings into the joints of flight controls of the push-pull rod type, which has substantially reduced the production time and brought the rejection rate down to virtually zero, from as high as 30%. The high rejection rate under the old method, in which a manufactured spinner was used to stake the bearing into the rod end, was caused by uneven pressure resulting from deflection in the tool.

Carpenter built a double-sided spinner with the correct radius for most of the bearings used, and found that, with the even pressure obtained on both sides of the tool, the time could be cut by about 60%. The double spinner, which can be used in a small drill press, turns the metal over evenly around the perimeter of the bearing, thus assuring a tight, permanent fit in perfect alignment. Rod ends as much as 10 or 12 thousandths oversize may also be used, where formerly they would have had to be scrapped or reworked. Workers can operate the handy tool efficiently with little or no previous experience.



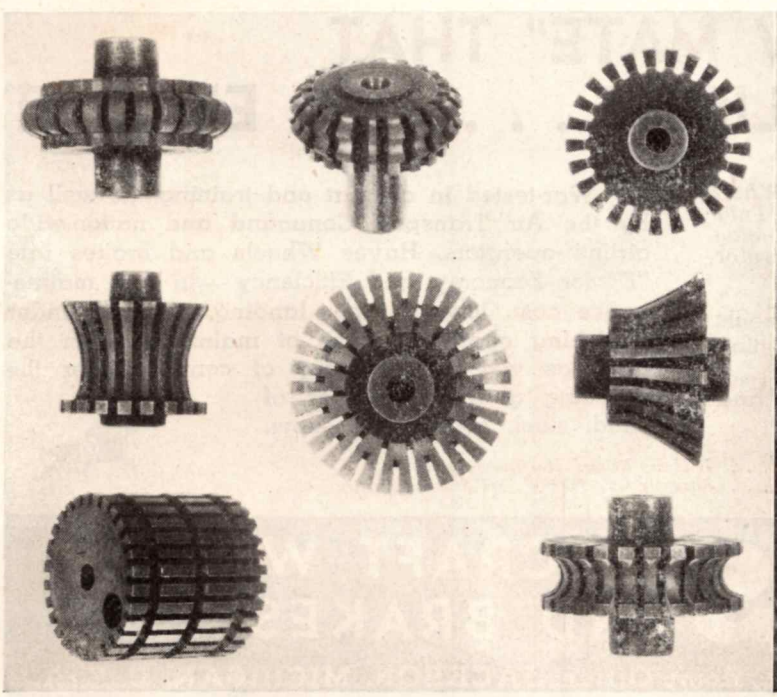
Double spinner, for use in small drill press, turns metal evenly around perimeter of ball bearing, assuring tight fit in good alignment. Developed by a Fairchild machinist

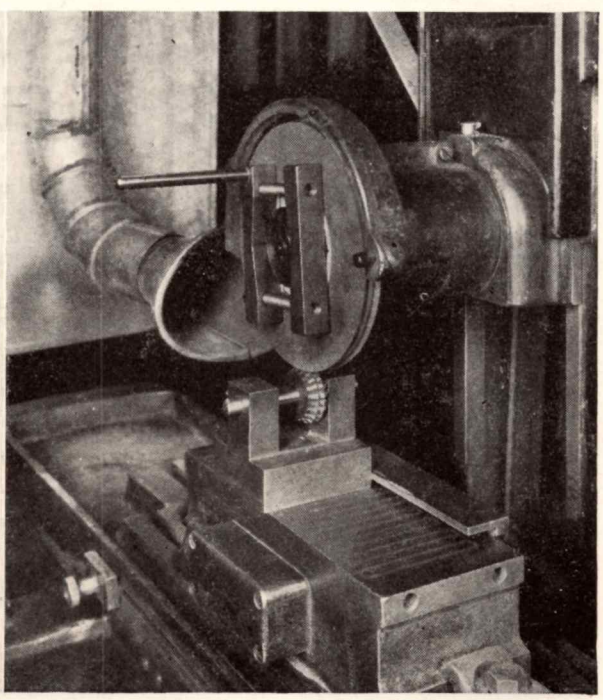
Truing Tool Forms Grinding Wheels Faster

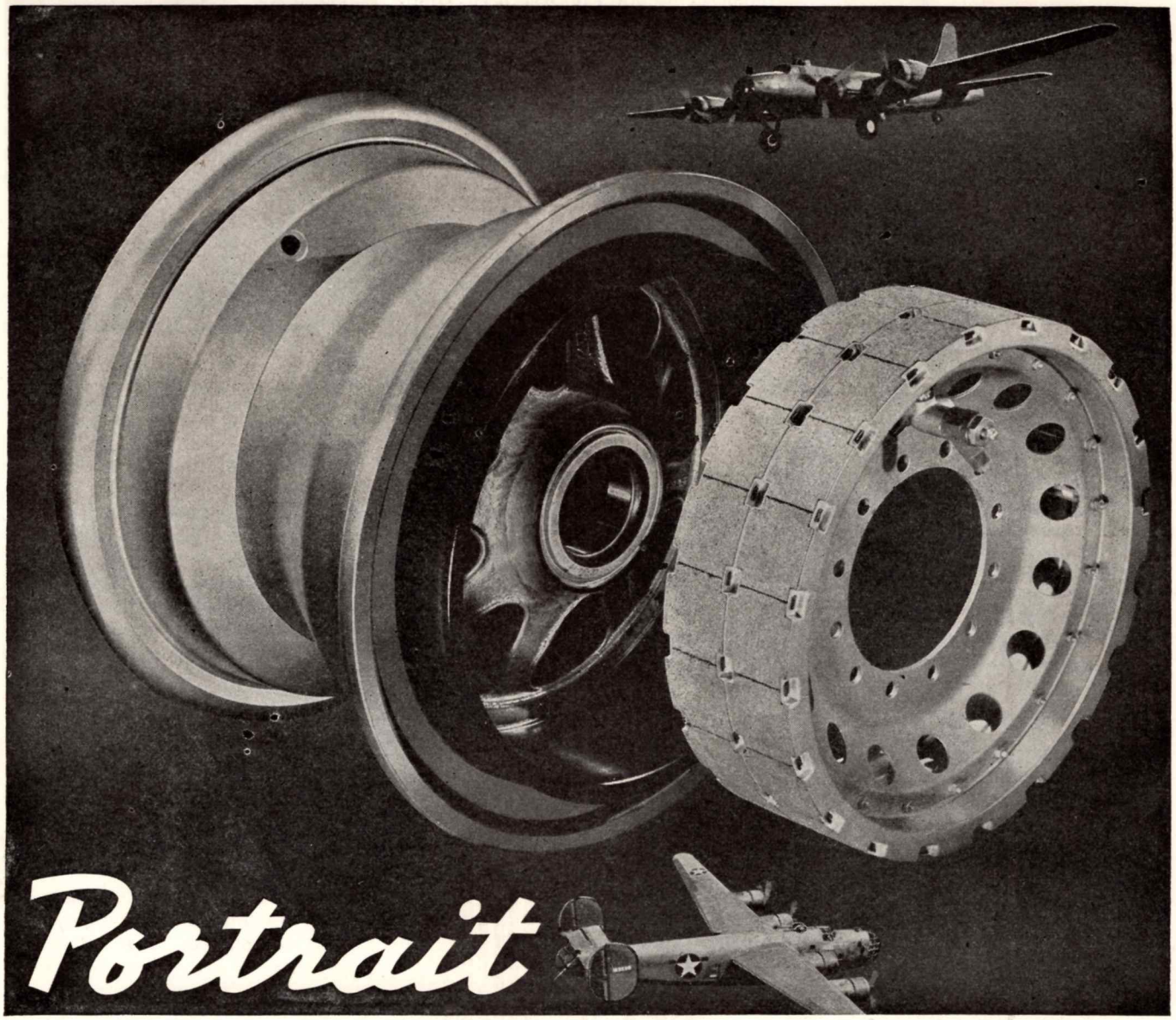
A set of truing tools devised at General Electric's West Lynn plant makes possible the accurate forming of grinding wheels to almost any desired contour, with a minimum of skill. These

(*Continued on page* 353)

Left: Truing tools made of carbon steel, for forming grinding wheels to desired contour. Right: Tool is mounted in holder provided with adjustable hardened male centers, and is fixed on a magnetic chuck. Operator revolves wheel by hand, feeding it down upon circular tool







OF A "CREW MATE" THAT STARTS A FLIGHT . . . AND ENDS IT

"THE PORTRAIT" *Hayes Aircraft Wheel and Expander Tube Brake as used on the C-46 and other ships. Boeing B-17 Flying Fortress and Consolidated B-24 Liberator (illustrated) are also Hayes equipped.*

Slugging fight or routine flight—Hayes Wheels and Brakes mean accurate ground control in getting the ship off and landing it . . . last to leave the ground and first on the return.

War-tested in combat and training, as well as by the Air Transport Command and nation-wide airline operators, Hayes Wheels and Brakes rate "E" for Economy and Efficiency — in low maintenance cost, low cost per landing, stamina under punishing operation, ease of maintenance in the field—as well as accuracy of control under the gruelling ground variables of sand, steel, concrete or snow.

Representatives: *Eastern . . . J. Henry Reisner, Hagerstown, Md.*
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HAYES AIRCRAFT WHEELS AND BRAKES . . .

HAYES INDUSTRIES, INC. **Home Office: JACKSON, MICHIGAN, U. S. A.**

(*Continued from page* 351)

tools have considerably speeded the forming operation, particularly where complicated shapes are involved.

The tools are made from plain carbon steel, hardened glass-hard. Radial saw cuts in the diameter of the tools are made after they have been turned on well-defined center holes. Spacing the saw cuts irregularly minimizes wear.

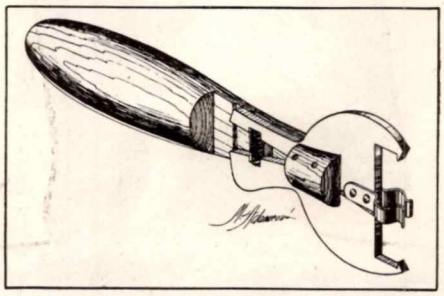
The tool is mounted in a holder provided with adjustable hardened male centers so that it revolves freely but with minimum play, and the device is then fixed upon a magnetic chuck. The operator revolves the wheel by hand, gradually feeding it down upon the circular tool. The wheel is rapidly formed to the desired shape, allowing the cut to run off so that the finish of the wheel face is smooth.

The wheel is then ready for form grinding. Ordinarily a part is rough-ground and the wheel retrued before finishing. The retruing operation requires only a short amount of time and it is not necessary to remove the work from the machine.

Fuse Remover Prevents Breakage and Burns

The changing of airplane fuses is an operation which often requires great delicacy due to lack of space. As a result, burnt fingers and broken fuses are a common occurrence in aircraft plants.

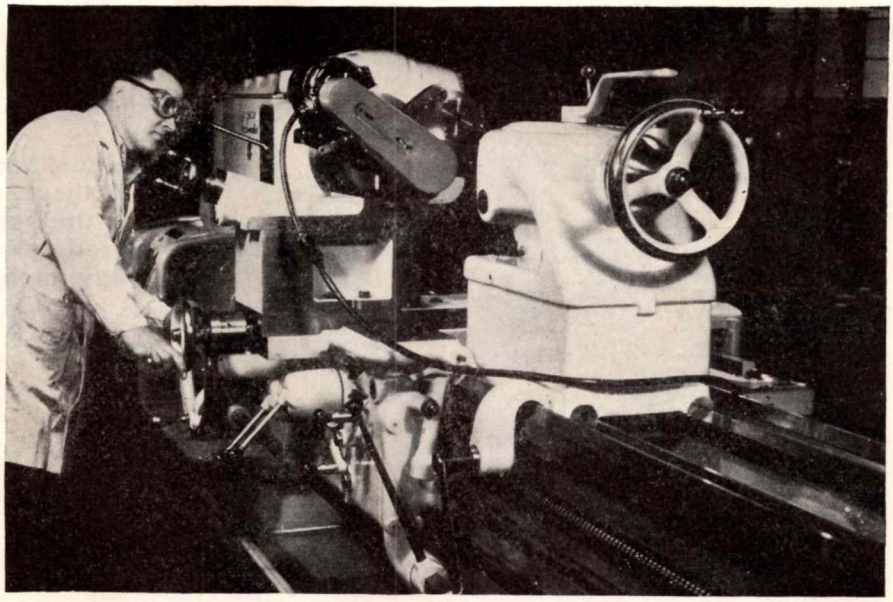
Designed and developed by Vega's Tool Engineering Department, a fuse remover tool has solved this annoying problem. The jaws may be expanded or contracted by thumb pressure for gripping purposes, and fuses may be changed quickly and efficiently by its use. Cost of the tool is approximately $15, and combined savings arising through decreased operation time, a decrease in the number of lost-time accidents, and reduced fuse breakage over a year is estimated at $5000.



This Vega tool changes airplane fuses without breaking them, and prevents finger burns

Painting System Improves Production Efficiency

Generally increased efficiency, less operator eye fatigue, fewer accidents and greater accuracy has resulted since the United Air Lines central maintenance base at Cheyenne, Wyo., adopted "three-dimensional" painting for machine tools in its machine shop. The new color system was developed by DuPont, and United Air Lines paints operational parts in buff, safeguards in orange, the balance in gray.

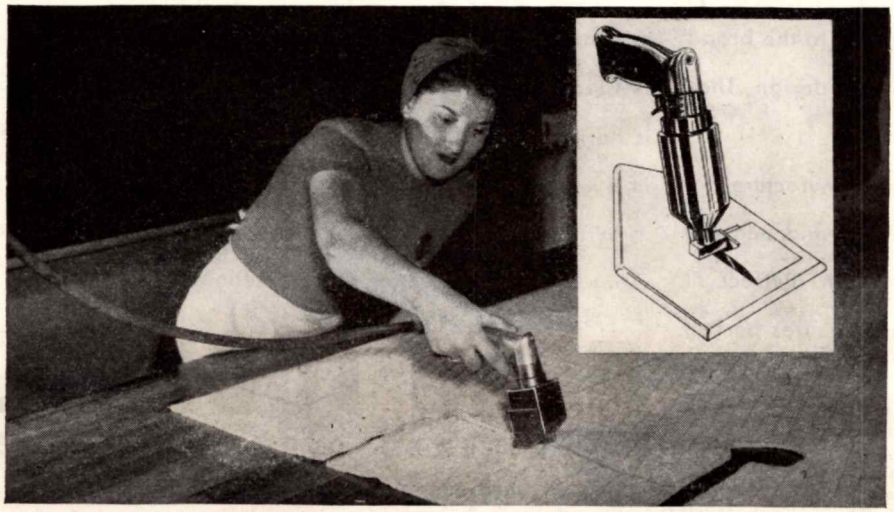


UAL'S "three-dimensional" painting system for machine tools increases production efficiency, reduces eye fatigue and accidents. Operational part in buff; safeguards in orange; rest of machinery in gray

Pneumatic Fabric Cutter Shortens Operation Time

A new cutter, designed by C. R. Corder, of Consolidated, cuts Seapack fabric and sound insulation at a considerable advantage over the tools formerly employed for this purpose.

The cutter's design enables an operator to cut fabric along a curved pattern or on sharp right angle corners. This feature makes it faster and more flexible than the disc type machine or hand shears on this type of work. The cutter is made from parts of sheet metal shears and a pneumatic motor.

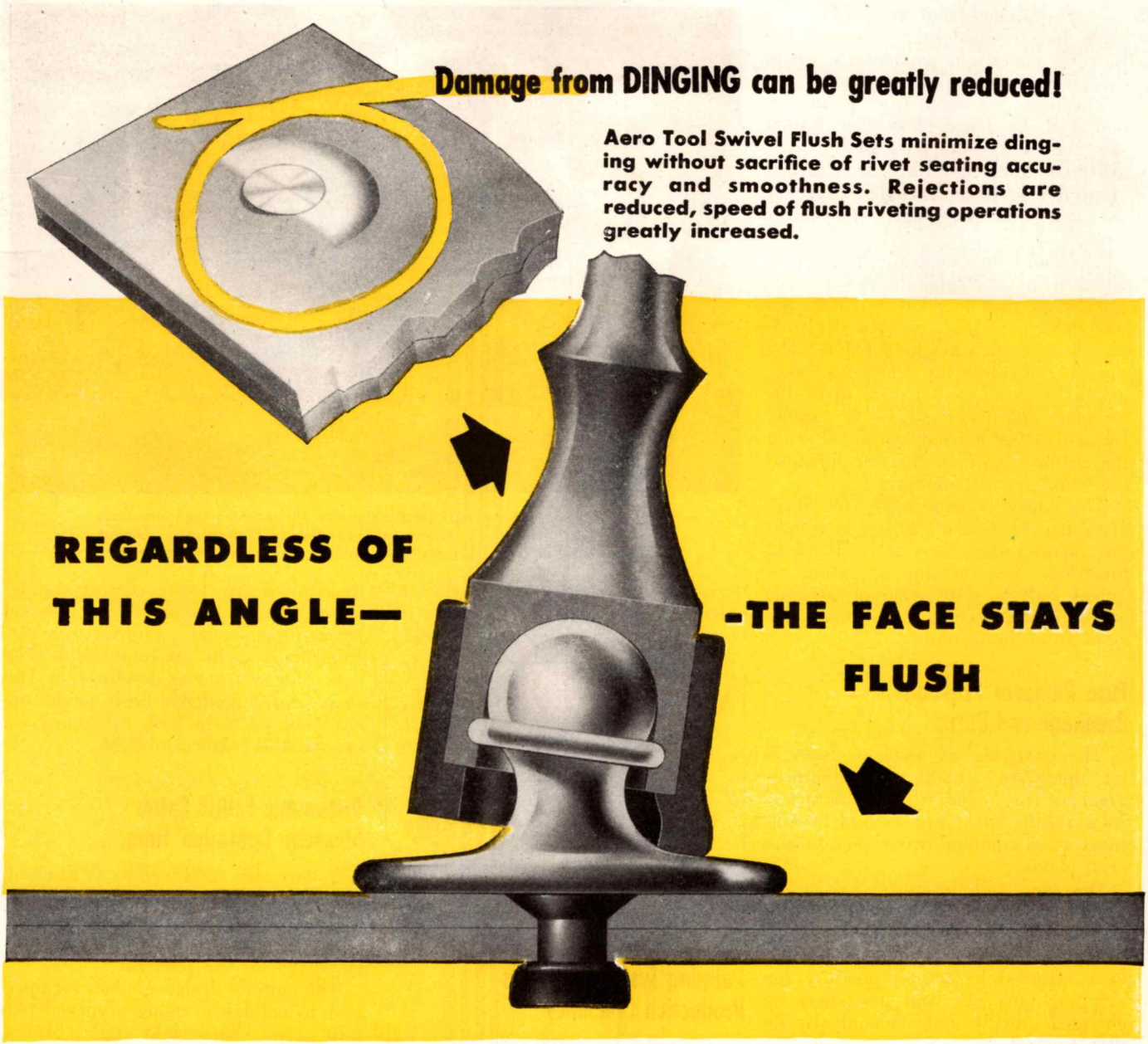


This pneumatic fabric cutter, operating along curved patterns or on right-angle corners, is faster and more flexible than disc type machines

New Device Facilitates Insertion of Rivets

Of special value in cases where inaccessible locations are involved, a new rivet-inserting tool, designed by W. S. Power, of Consolidated Aircraft, is saving considerable time and trouble on the metal bench. The tool consists of a short piece of ¼-in rod, threaded on one end and flattened and slotted on the other. The flattened end has a short strip of spring bronze riveted to each side of it, one of which is slotted for half its length. The spring action of the slotted strip holds a rivet securely

(*Continued on page* 355)



Aero Tool SWIVEL FLUSH SETS Are Engineered for Green Hands

When these Sets are placed in the hands of unskilled labor better results are immediately noticeable, due to the broad angle of safety incorporated in their special design. They seat flush regardless of shank angle.

Typical Aero Tool precision design and manufacture are evident in all details of construction. Shank and Bell are of *forged* steel for great structural strength. Perfect fit between Ball and Socket prevents binding, assures perfect swivel action. Mirror-polished Full Crown Face eliminates excessive skin marking.

Cleaning and oiling are quickly done; the retainer collar is easily removed, the unit disassembled and re-assembled in a matter of seconds.

Write for catalog listing these and other Aero Tool Precision Products for better, faster riveting.

BLURPING IS NOT POLITE
...even for a rivet gun. Don't "blurp" a pneumatic rivet hammer when the rivet set is not in the gun—it causes immediate damage to piston and set bushing, takes valuable time to repair. Be careful—conserve tools!

AERO TOOL CO.
ENGINEERED AIRCRAFT TOOLS
231 West Olive Avenue, Burbank, Calif. • Department AD-9

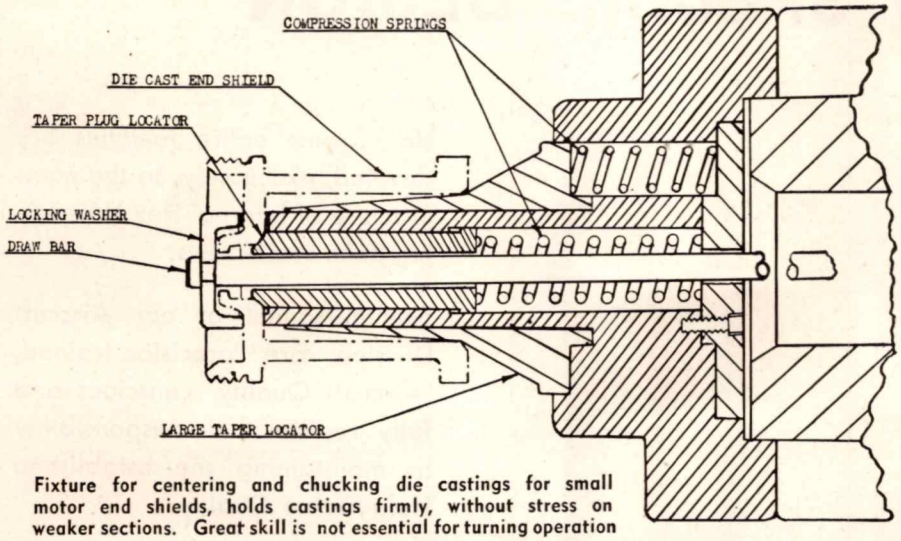
(*Continued from page* 353)
enough for maneuvering into desired location. A standard screw-driver handle is provided, with extensions of various lengths.

Castings Centered and Chucked in New Fixture

The chucking and centering of pressure die castings for small motor end shields is accomplished simultaneously by means of a special chucking fixture developed by A. J. Green, a general foreman at a General Electric plant manufacturing aircraft parts.

The fixture employs a spring-mounted tapered plug and a similarly mounted tapered ring which locate the bearing bore and the edge of the stator fit. The end shield is located against a three-point stop which contacts the inside of the end flange, evenly dividing excess stock in the casting. The end shield locates first against the spring mounted plug, assuring a concentric location of the outer end, and then is pushed back until it locates solidly against a three-point stop.

Coincidentally, contact is made at the inner end on the large taper locator, obtaining a concentric location of the large fit. The air-operated draw-bar pulls a horseshoe washer which has three locating points directly opposite the point on the stop.

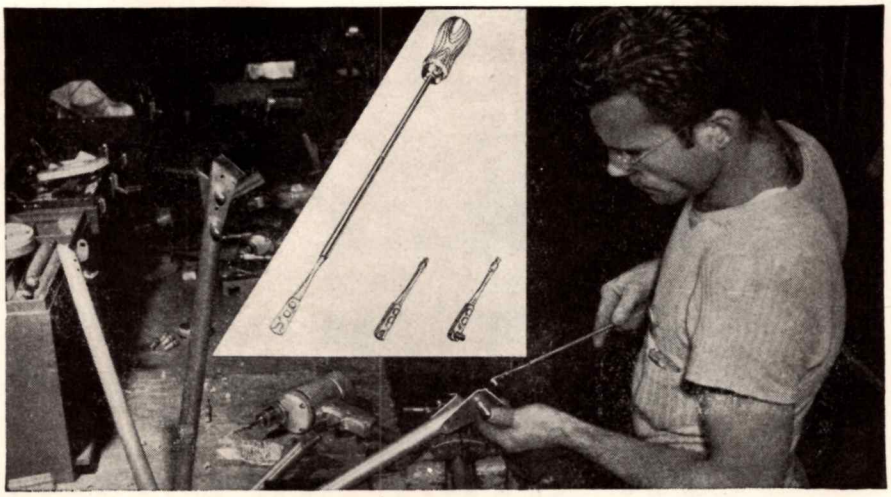


Fixture for centering and chucking die castings for small motor end shields, holds castings firmly, without stress on weaker sections. Great skill is not essential for turning operation

This arrangement permits the casting to be solidly held without stressing any of the weaker sections, since the holding force is applied directly in compression against three points through the end flange. When the air cylinder has drawn up to its full stroke, the casting is held accurately and solidly, and the resulting turning operations may be done quickly and accurately without necessitating the use of highly skilled or experienced operators.

Correction

The reference to J. S. Pitisci in the item, "Regreasing Adds to Service of Rod End Ball Bearings," published on page 457 of the July issue, identified him, incorrectly, as being affiliated with United Air Lines. Mr. Pitisci is a member of the *Eastern* Air Lines staff at its engine overhaul shop in Miami, Fla.

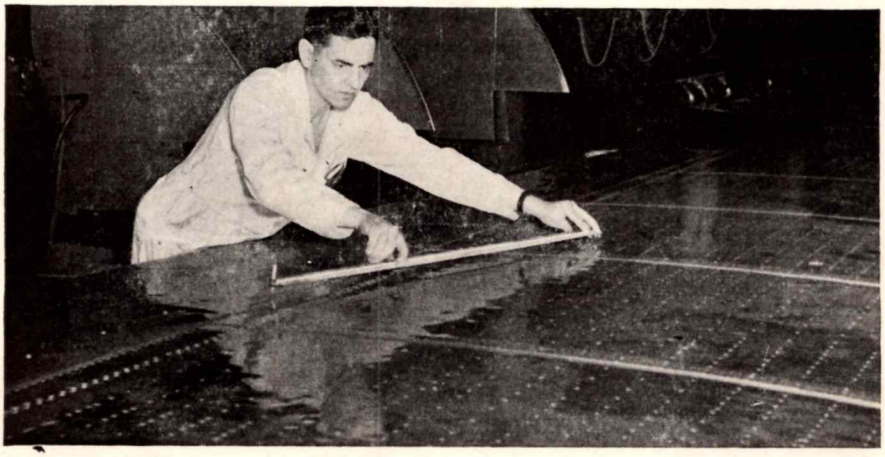


Rivet-inserting tool saves time and trouble on metal bench. Consists of 1/4-in rod, threaded on one end, flattened and slotted on other. Spring action of slotted strip holds rivet securely

Eliminate Extra Man in Scribing Insignia Circle

The conventional method of laying out the star circle on airplane wings was to use a bulky wooden template, around which the circle was scribed. To accomplish this, one man had to climb on top of the wing and mark the circle while the other man held the template.

Al Pauser of the paint shop at the Murray Corporation mounted his pencil on a stick the length of which was equal to the radius of the circle. At the other end of the stick is a vacuum cup mounted on a pivot. Now one man can swing the stick in a circle and complete the job in short time.

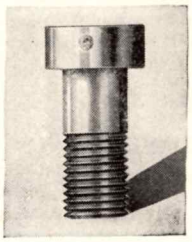


Compass fashioned of wooden arm having vacuum cap and pencil at extremities, replaces wooden template and eliminates one of two men used in old method of scribing star circle on plane wings at Murray Body

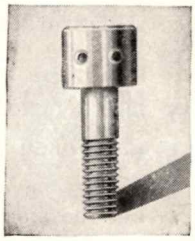
HOLO-KROME

Internal HEX Wrenching BOLTS

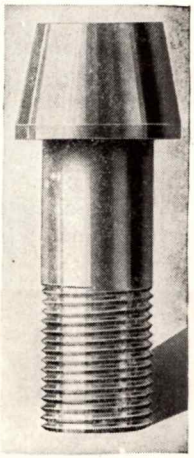
TO NASC SPECIFICATIONS AND TO SPECIAL DESIGN



SPECIAL LANDING GEAR



SPECIAL WING TIP



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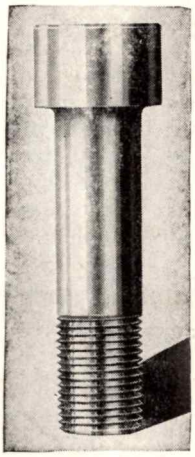
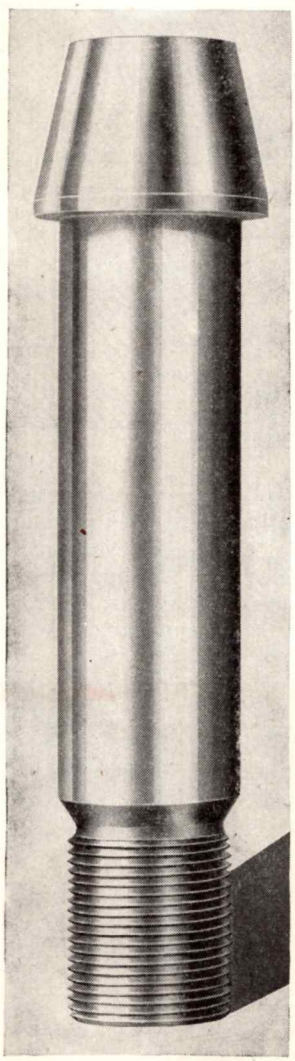


SPECIAL WING ATTACHMENT

Specifications of these and other Holo-Krome Internal Wrenching Products plus data on this better fastening method — shown in our Aircraft Catalog.



MOTOR MOUNT

Holo-Krome entire facilities are devoted, exclusively, to the manufacture of Internal Hex Wrenching Bolts and Screws.

The personnel of our Aircraft Division are precision-trained, "Aircraft Quality" conscious and fully realize their responsibility in maintaining the established Holo-Krome Quality.

Holo-Krome experienced Fastening Engineers talk the "aircraft language." Aircraft fastening problems are their business. Feel free to consult them anytime.

FOR YOUR COPY WRITE DEPT. A3

AIRCRAFT DIVISION — THE HOLO-KROME SCREW CORP., HARTFORD 10, CONN., U. S. A.

AIRCRAFT PRODUCTION LAG DUE TO LABOR PROBLEMS

August Output of 7700 Units a New High but Fell Short of Quota—Many Factors Involved

Preliminary figures indicate that 7700 aircraft were produced in August, an increase of 4% over the July figure of 7373, which was itself higher than any previous month. Indications are that while 8000 aircraft will be reached this month if the upward trend is maintained, this year's goal of 10,000 monthly will not be hit until March 1944.

Coincident with the announcement of probable August production, the Government has opened a drive for more aircraft workers, and the Army and Navy have renewed their call for legislation to draft workers for critical jobs. The Austin-Wadsworth bill, now before Congress would empower the President to direct men between 18 and 65 and women between 18 and 60 to specific war jobs where calls for volunteers fail or are impractical. At a meeting of officials of the War Manpower Commission and Office of War Mobilization measures such as wage incentives, special draft deferments for key workers, labor hiring priorities and concentration on the most offensive types of aircraft were recommended.

Manpower Draft?

Returning from a trip to England, Eric A. Johnston, president of the United States Chamber of Commerce comments on the national service and says that while he hopes we can maintain the voluntary system here we must do everything necessary for victory, even if it means an all-out draft of workers to meet strategic production problems.

Various causes are cited as attributing to the relative underproduction, while many authorities consider the standards set as unrealistically high. It is said that the Office of War Mobilization is faced with the problem of finding 700,000 new employees for the aircraft industry in the next twelve months if it expects to reach the goal. Bernard M. Baruch, special adviser to the war mobilization director, is understood to have requirements of 58,000 additional employees each month for the next year if the projected peak production is to be reached. Labor shortages varying from 3000 to 10,000 in individual plants are reported.

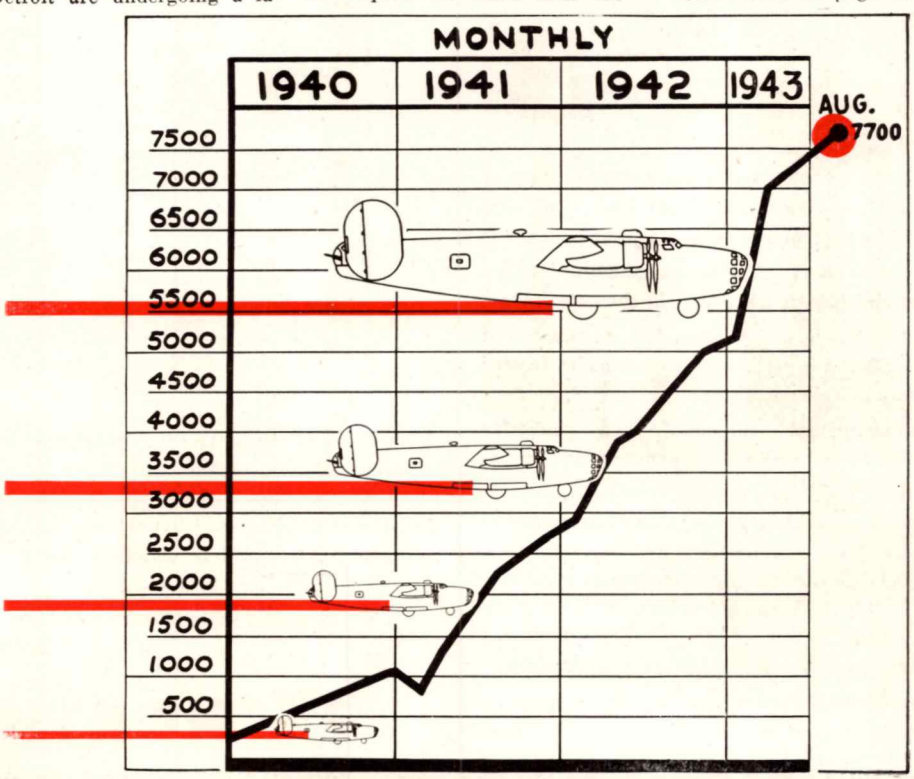
The West Coast has the most complicated situation at the present and it is predicted by officials in that area that the same problems would arise in Eastern areas such as Baltimore, Long Island and Buffalo. It was pointed out that the Ford plants in Detroit are undergoing a labor turnover as acute as the West Coast plants also. The draft is not given as the main reason for the manpower shortage, as half of the aircraft workers are women. Only a little less than 15% is charged to the draft while a womanpower shortage has arisen because women have found that poor laundry service, shopping for food with ration points and scarcity of domestic help are creating such problems in the home that they find it necessary to give up factory work.

Women's Employment Declining

Miss Margaret Hickey, chairman of the Women's Advisory Committee of the War Manpower Commission and Dr. William Haber, assistant executive director, say it will be extremely difficult to meet our goal unless the declining rate of women's employment is reversed. Miss Hickey states that the number of women who leave their jobs often exceeds those who enter the plants. This condition will necessitate the request for more than the requirements of 1,000,000 women in order to handle the turnover. According to Dr. Haber, women are basically the only reserve left to meet the production goals. As a result a second recruiting campaign is under way since inadequate community facilities are burdening women in war jobs. This campaign is attempting to recruit women to the unglamorous jobs of laundress and day nursery helper. Plants are also being urged to adopt four-hour shifts, although this means hiring twice as many women. A new group being called upon are the housewives between 20 and 55 without children under 16.

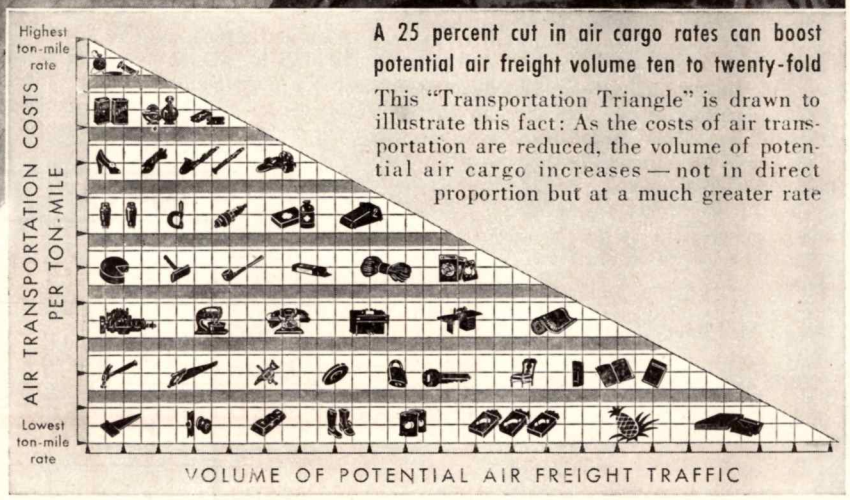
An important reason for production lag is the increased number of changes in design of airplanes necessitated by developments on the battlefronts. Men who are returning to the farm or have left for health reasons constitute 13% of the turnover while others are changing because of transportation difficulties, housing conditions

(*Continued on page* 359)



How our aircraft production has soared since 1940. August reports indicate that American plants built 7700 units in August

PREDICTION: Postwar freight will fly ... at less than 15 cents a ton-mile



A 25 percent cut in air cargo rates can boost potential air freight volume ten to twenty-fold

This "Transportation Triangle" is drawn to illustrate this fact: As the costs of air transportation are reduced, the volume of potential air cargo increases — not in direct proportion but at a much greater rate

AFTER VICTORY looms one certainty: Out of America's war-accelerated research will come new and different airplanes for a world at peace.

Airplanes so advanced as to make obsolete the newest and largest transports in the skies today.

Planes of new, unorthodox design—capable of carrying larger loads longer distances with greater economy in operating costs.

Giant land and seaplanes. "Shuttle" craft for short hauls. Express planes of incredible speed.

In these airplanes America's postwar products and American technicians will have the means to go fast and far to markets anywhere on earth—to unlock the world's commerce—and create new horizons for the better material welfare of us all.

Knowledge U. S. aircraft designers already possess is enough to guarantee this prophecy. For aircraft now on drawing boards can be operated profitably at rates below 15 cents per ton-mile. The rates for air freight before the war were from 80 to 90 cents per ton-mile!

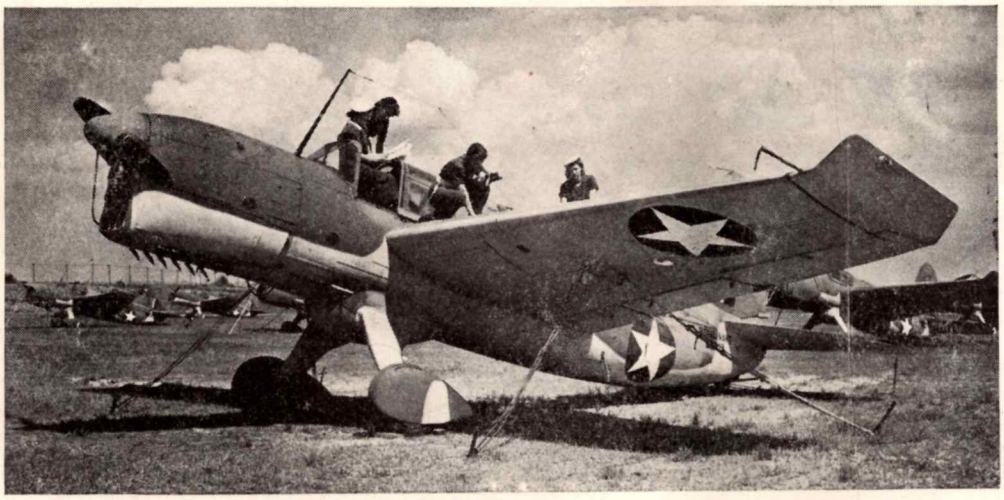
With the coming of victory, Northrop accomplishments, together with those of other U. S. leaders, will contribute to a new world of peace and opportunity. A more desirable world in which to live.

Meanwhile all the resources of Northrop in plane design and plane construction are devoted solely to producing the planes of war. The planes that bring closer the day of complete victory for the Allies.

NORTHROP *Aircraft, Inc.*

NORTHROP FIELD, HAWTHORNE, CALIFORNIA

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.



Curtiss SO3C-1 "Seamew" (English for "Seagull") gets a final checkup from four British WRENS at Roosevelt Field, N. Y. These girls, members of a corps of 27 stationed at the field, check all parts and equipment on aircraft for the RAF

(*Continued from page* 357)
near the plants or dismissals. One employer cites the unfamiliarity of sounds and newness of the job as causing a turnover in personnel but this had been reduced by indoctrination tours which give the new employees a small feeling of "know-how" to start their jobs.

At the present time Maj. Gen. Lewis B. Hershey, director of selective service, is issuing a 60-day moratorium for aircraft workers for a "breathing spell that will provide an opportunity for selective service to work out a permanent policy for the aircraft industry."

"Personal" Plane Builders Organize ACC Division

An organization to promote the use of airplanes as personal transportation has been formed by the manufacturers of small aircraft. The group, the Personal Aircraft Manufacturers Section, proposes to become a separate section of the Aeronautical Chamber of Commerce but if the conditions outlined are not acceptable to the Chamber's board of governors it is understood it will function independently.

Elected chairman of the section was Dwight S. Wallace of Cessna. Other officers are: Carl Squire, Lockheed; C. J. Brukner, Waco, and W. T. Piper, Piper, all vice-chairmen, and Richard DePew, Fairchild, secretary.

Projects to be undertaken by the PAMS include requests for certain changes in the CAA requirements for private licenses which will be more concerned with what PAMS designates the practical consideration of how to fly. Weather reporting was discussed as the greatest single barrier to public flying and suggestions were made to the effect that weather hazards could be minimized by making available to the public a usable and dependable weather reporting service.

Other subjects discussed at the initial meeting included: physical requirements set up that fit the average healthy American man or woman; practical and simple contact flight traffic regulations; insurance without restrictive clauses; coordination of state and national regulatory bodies; a smooth liaison within the industry, and a sound sales policy.

Representatives of the following companies were present at the meeting: Aeronca, Beech, Cessna, Consolidated, Culver, Douglas, General, Grand Rapids, Globe, Fairchild, Howard, Interstate, Kaiser, Martin, Northwest, Aeronautical, McDonnell, Piper, Republic, Ryan, Vega, Waco and Thaden Engineering.

Packard Producing Revised Merlin Engine

Production of a revised Rolls-Royce Merlin aircraft engine incorporating a two-speed, two-stage supercharger has been announced by the Packard Motor Car Co. The engine now powers the North American P-51 *Mustang* with the horsepower stepped up to more than 1500. The Merlin-powered *Mustang* supplants the original design.

For almost two years Packard has been producing Rolls-Royce power-plants for *Warhawks*, British *Hurricanes*, four-motored *Lancasters* and Canadian-built *Mosquitos*.

The new supercharger was jointly developed by British and Packard engineers with cooperation of the U. S. Army Air Forces in testing and approving the design.

Packard engine output has been more than doubled.

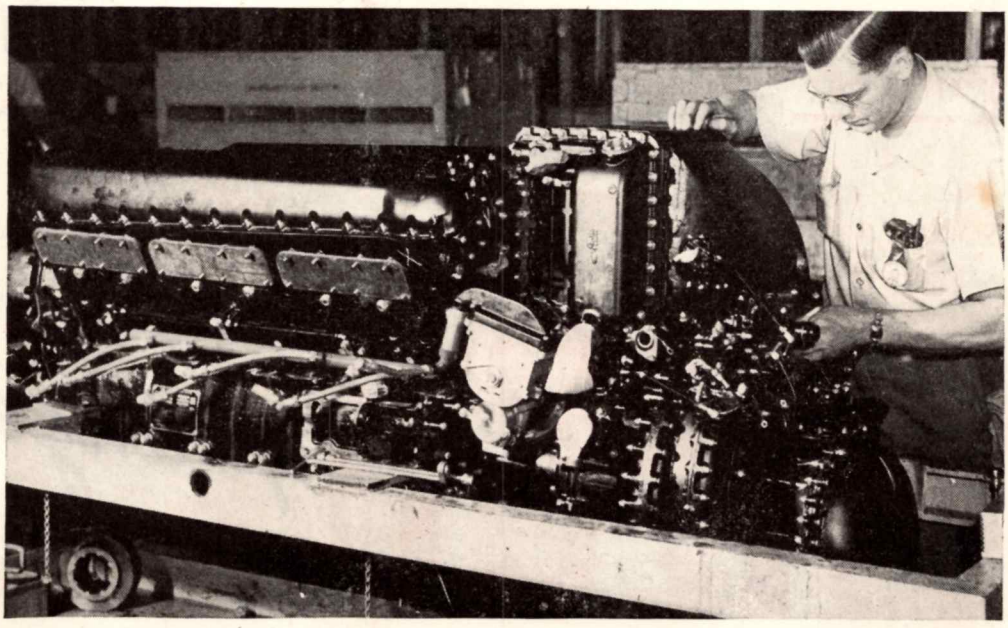
Brazil to Build Ranger Engines

A group of Brazilian officials, headed by Dr. Carlos Martins Pereira e Sousa, ambassador to the United States, witnessed the signing of a contract by the Republic of Brazil to build Ranger airplane engines to power the Fairchild M-62, primary trainer. Identical with the AAF's PT-19, the trainer is already in production in Brazil.

Negotiations, which have been carried on for several months between the company and Brig. Gen. Antonio Guedes Muniz, aircraft designer and director general of the Brazilian Government aircraft engine factory, were completed during the recent visit to the United States of Air Minister Joachim Pedro Salgado.

By terms of the agreement, Fabrica Nacional de Motors, the Brazilian Government's newest engine plant, will manufacture the six-cylinder *Ranger* inverted inline air-cooled engine with the use of drawings and manufacturing data of engines, jigs, tools and fixtures supplied by Fairchild. The motor will be used also to power the Brazilian Muniz M-9 biplane and the twin-engined Grumman Widgeon, which are both part of the Amazon military and coastal patrols and mail delivery.

(*Continued on page* 361)



Packard-built Rolls-Royce "Merlin" aircraft engine with two-speed two-stage superchargers. This revised British design is now being used in the "Mustang"

. . . we've got horseshoe nails in our Flying Fortress

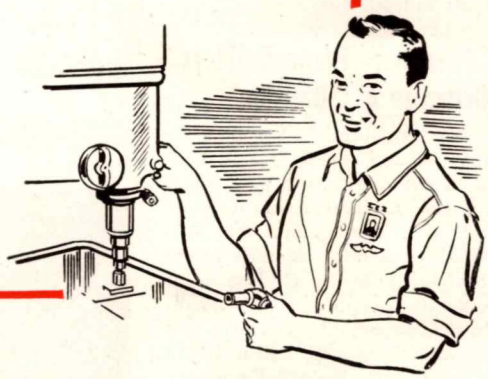
★ Remember, Dad, how you used to keep trying to impress on me the importance of little things? And the story you probably repeated a thousand times for my benefit . . . the one about the horseshoe nail that failed, losing the shoe, the horse, the king and, finally, the kingdom?

It all came back to me today when we were checking our plane after a mission over you-know-where. It was one of my duties to examine tube, pipe and hose fittings . . . you know, the little gadgets that guard connections in our gas, oil, water and oxygen lines. *They are the horseshoe nails of our planes, Dad!*

But *these* horseshoe nails stay in place! Every one was shipshape. Perhaps that's because of the swell job of the plane builders back home, and the parts workers who must be as careful as watchmakers in turning out these fittings.

Maybe it's because Americans everywhere must realize now, Dad, that the total of all the seemingly smaller things will win us earlier victory . . . the horseshoe nails like the $18.75 War Bond, the extra hour at the machine, the rivet for a battleship and the fitting for a plane.

Jack



DEAR JACK: Count on it that we who make AFCO Fittings for your planes will continue to be "as careful as watchmakers". Our business is to make nothing but aircraft fittings, and so exactingly that they will earn a place in your private plane of tomorrow as they have in your warcraft of today.

AFCO Fittings

ARMY E NAVY

NEW "A-N" TUBE, PIPE AND HOSE FITTINGS

FITTINGS OF QUALITY FOR PLANES OF WAR AND PEACE

The Aircraft Fitting Company ★ 1400 East 30th Street ★ Cleveland, Ohio

(*Continued from page* 359)

Fairchild will also furnish complete working drawings of assembly and will provide the facilities of the Ranger plants at Farmingdale and Jamaica for the training of Brazilian engineers and mechanics. The firm will send knocked-down engines to Brazil for similar purposes.

Cessna Honored for War Bond Promotion

Cessna Aircraft Co., of Wichita has been awarded a U. S. Treasury Department citation in recognition of the company's promotion in the sale of War Savings Bonds. The company's national advertising program offers a "priority delivery plan" by which persons wishing to buy Cessna's "Family Car of the Air" after the war can be assured of one of the first models.

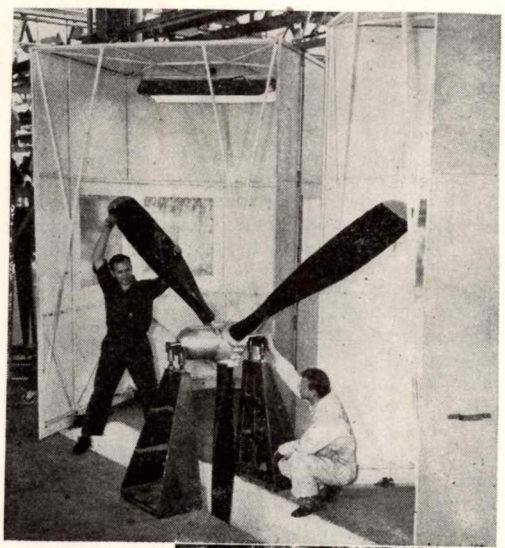
The prospective buyers are required to list with Cessna their serial numbers in war bonds in the amount of $25 for a temporary priority or $500 in war bonds for a permanent down payment. The average listing to date has been almost $800 and has come from nearly a thousand persons in the United States, Canada and South America.

East Coast AWPC Elects Bell

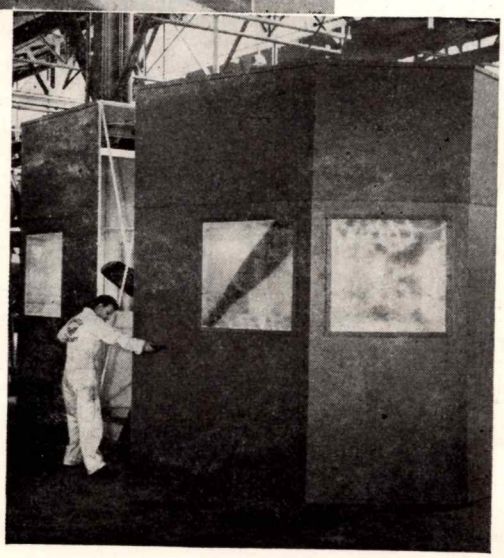
Lawrence D. Bell, president of Bell Aircraft Corp., has been elected president of the Aircraft War Production Council, East Coast, Inc., succeeding J. Carleton Ward, Jr., president of the Fairchild Engine and Airplane Corp. The vice-presidency has been assumed by L. C. Goad, vice-president of General Motors Corp., and general manager of GM's Eastern Aircraft Division. The term of office in each case is four months.

Plans have been completed for a joint meeting of the boards of directors of the West Coast Council and the East Coast Council in New York next month, at which wartime production of planes, manpower, materials and other problems will be discussed.

Other officers elected are Ken Ellington, secretary; Francis T. Boyd, assistant treasurer; and C. M. Vandeburg, general manager.



Left: Propellers for Brewster-built "Corsairs" are set up in preparation for balance tests in portable still-air testing room



Right: The room is closed and the blades can be seen through the windows

Here's where Your Sealing Problems STOP!

3-M ADHESIVES

Sealing riveted or welded joints of tanks or containers often prevents leakage when these same tanks or containers are exposed to the pressure and action of various solvents and chemicals.

Providing 3-M Adhesives for this type of work is just one example of how 3-M Adhesives are today meeting wartime problems.

A full line of peacetime adhesives has been expanded to over 100 in number to meet these many new demands. There are 3-M adhesive coatings, impregnating fluids, sealants and sprayon insulators.

A 3-M Adhesive Engineer will be glad to help you select the ones best suited to your needs.

MINNESOTA MINING & MANUFACTURING CO.
Saint Paul 6, Minnesota
ADHESIVE DIVISION, DETROIT 2, MICHIGAN

Gentlemen: AD 943
Please have a 3-M Engineer call to discuss our adhesive needs.

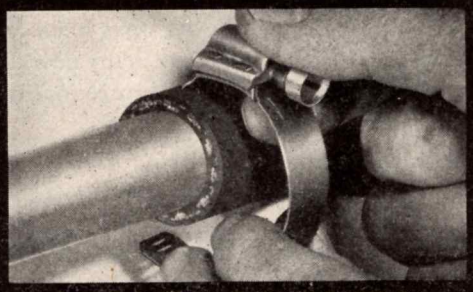
Name.....
Department.....
Company.....
Address.....
City..... *Zone*..... *State*.....

★ BUY WAR BONDS ★

AIRCRAFT Standard PARTS CO.

"Aero Seal" HOSE CLAMPS

- EXTREMELY COMPACT
- RAPID ACTION
- UNIFORM PRESSURE ON HOSE
- NO LOOSE PIECES
- SELF-LOCKING
- SMALL NUMBER OF SIZES
- 3" TAKE-UP IF NEEDED
- SAFETY CUP ON SCREW HEAD
- COMPLY WITH AAF SPECIFICATIONS

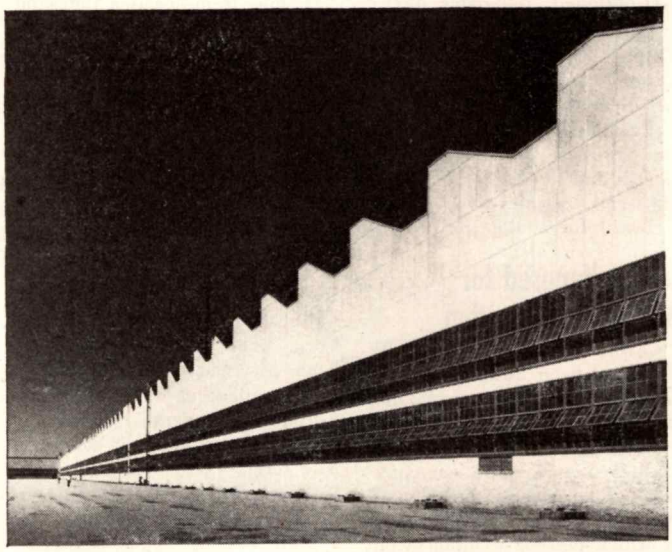


CAN BE INSTALLED OVER HOSE IN PLACE ON PIPE — NO LOOSE PIECES

A new and better hose clamp for the aviation industry. Compact, convenient, easy to operate, strong, quality-built, and durable. Operates on worm and worm-gear principle. Write for circular giving complete data and prices.

AIRCRAFT STANDARD PARTS CO.

1711 19th Ave., Rockford, Illinois



Side-wall and sawtooth roof construction provides ideal daylight working conditions in this new all-timber Douglas Chicago plant, designed by the Austin Co., where "Skymasters" are being built

Bell has been associated with the aviation industry for 30 years, having served with Glenn L. Martin until the mid-twenties when he was general manager of the organization. In 1928 he joined Consolidated Aircraft and a year later was elected vice-president and general manager. In 1935 Bell and two associates formed Bell Aircraft Corp.

Wynne Forms Law Firm

John S. Wynne, formerly chief of the enforcement section, chief of the airport section and assistant to the director of the Bureau of Air Commerce, United States Department of Commerce (now the CAA), has formed a law partnership with Jo V. Morgan, recently resigned as the sole member of the Board of Tax Appeals of the District of Columbia. They will practice before the courts of the District of Columbia, the Supreme Court of the United States and various administrative agencies of the Federal and District governments.

For the past several years Wynne has been engaged in the practice of administrative law, specializing in aviation matters.

Training Command Is Reorganized

The Army Air Forces Training Command has undergone reorganization with the merging of the regional and headquarters functions of the former flying-training and technical-training commands. A newer step in the reorganization of the two commands divides the coast-to-coast air-educational system geographically into western, central and eastern regions. Flying, technical and basic-training functions will be closely co-ordinated within each of the areas. The training command is the largest single command in the Army with headquarters outside of Washington.

The three flying-training centers which operated under the old Flying-Training Command have been renamed the Army Air Forces Western Flying Training Command, which is under the command of Maj. Gen. Ralph Cousins, Santa Ana, Calif. Central Flying Training Command, headed by Maj. Gen. Gerald C. Brant, Randolph Field, Tex., and the Eastern Command directed by Maj. Gen. Thomas J. Hanley, Maxwell Field, Ala.

Flying-training wings, each commanded by a general officer, will continue operating within the flying-training commands established on a functional basis.

These wings will serve to coordinate flying-training activities at the various schools to comply with directives from higher headquarters.

The districts of the former Technical Training Command have been made into three technical training commands, which discontinues the old Technical Training Command headquarters at Knollwood Field, N. C., and the third and fifth technical-training districts with headquarters at Tulsa, Okla., and Miami Beach, Fla., respectively.

Directing the new Western Technical Training Command with headquarters at Denver is Maj. Gen. John F. Curry; Central Technical Training Command at St. Louis, Mo., Maj. Gen. Frederick L. Martin; and Eastern Technical Training Command at Greensboro, N. C., Maj.

Gen. J. E. Fickel. Each of the major activities within the technical training commands is to be commanded by a brigadier general. The facilities of Tulsa and Miami Beach have been taken over by the three new technical training commands.

"Marauders" Touring War Plants and Bases

Three battle-scarred Martin *Marauders* manned by their hero crews have begun a tour to warplants and Army training bases throughout the country. The nation-wide trip was inaugurated at the Glenn L. Martin Co.'s war production drive rally recently when the men and women who helped build the aircraft heard the intrepid crews describe their combat experiences.

Participating in 50 sorties, "Old Hellcat," one of the three veteran medium bombers, has downed four German ME 109 fighters and has sunk five ships including a 12,000-ton merchantman. The second airplane, "Lady Halitosis" has made 43 sorties, downed six German fighters, sunk three submarines, one ship and released 67,000 lbs of bombs on enemy objectives. The third ship on tour, "Jabbo the Sky King II" has made 37 sorties, sunk two Axis ships and downed seven Axis aircraft.

The fuselages and wings of the ships give evidence to the flak, machine gun and cannon fire they have weathered since they were trundled out of the final assembly hangar at the Martin Army Division more than a year ago.

Itinerary of the crews and their *Marauders* is as follows: Baltimore, Md.; Rochester, N. Y.; Springfield, Mass.; Rome, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Middletown and Harrisburg, Pa.; Indianapolis, Ind.; Louisville, Ky.; St. Louis, Mo.; Des Moines, Iowa; Pierre, S. D.; Minneapolis, Minn.; St. Paul, Mo.; Milwaukee, Wis.; Chicago, Ill.; Listerhill and Sheffield, Ala., and Warner Robins, Ga.

Dowty Equipment Corp. Becomes Hub Industries

Hub Industries, Inc., is the new name of the Dowty Equipment Corp., manufacturers of landing gears, gear pumps, hand pumps and related products. No change has been made in the management of the company which remains as follows: Col. Henry Breckinridge, chairman of the board of directors; Alec E. Ulmann, president; Maj. Gen. (Ret.) Walter A. DeLamater, vice-president; H. A. Goldstein, vice-president, and Thomas F. Hanley, treasurer and general manager.

"E" Awards

For excellence in war production, the following companies recently have been given the Army-Navy "E" Award:

Abrasive Machine Tool Co., East Providence, R. I.

Acme Pattern & Tool Co., Inc., Dayton, Ohio.

Aeronca Aircraft Corp., Middletown, Ohio.

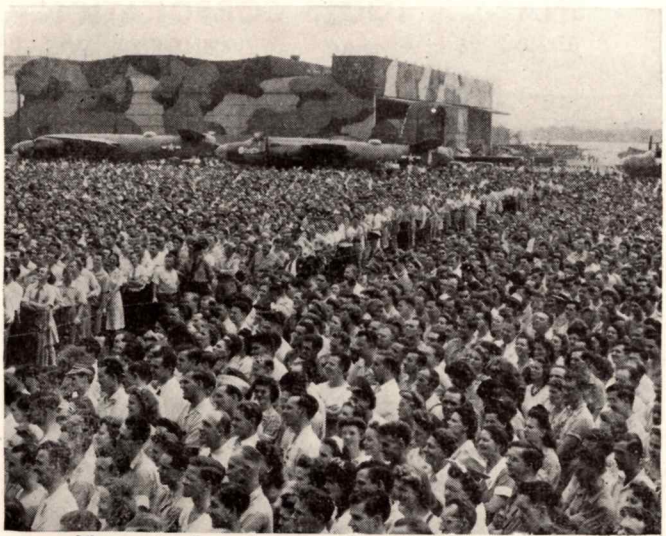
Aircraft Accessories Corp., Burbank; Kansas City, Kan.; New York City.

Aircraft Fitting Co., Cleveland, Ohio.

AiResearch Mfg. Co., division of the Garrett Corp., Los Angeles, Phoenix.

Barnes-Gibson-Raymond, Division of Associated Spring Corp., Detroit, Ann Arbor, Mich.

(*Continued on page* 365)



Thousands of employees at Glenn L. Martin Co. hear pilots relate their experiences with "Marauders" in many missions in the air battles over Africa and Sicily

AERO SCREW COMPANY

SEE "AEROSCREW" FOR...

STEEL DRILLED HEAD AIRCRAFT BOLTS

Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.

DRILLED FILLISTER HEAD MACHINE SCREWS

Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross-drilling is desirable, nickel steel screws conform to Navy drawing NAF-1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

We are Specialists . . .

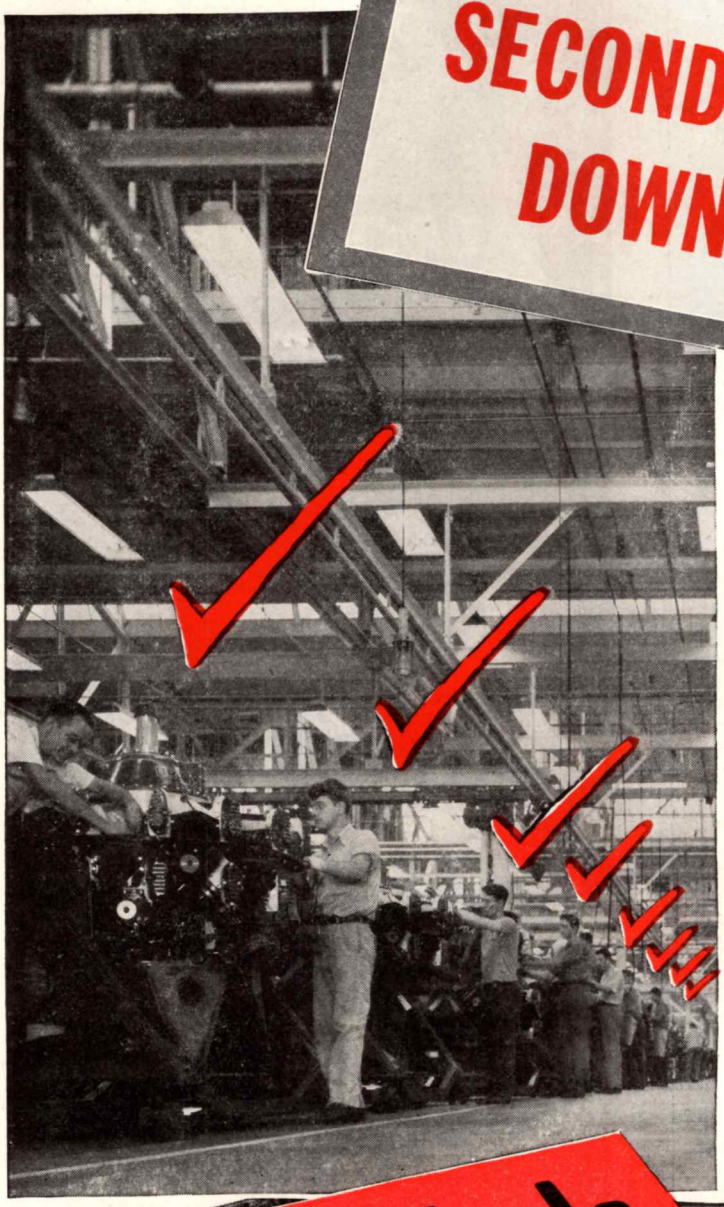
in the manufacture of selected items of aircraft hardware. In addition to the above, we can furnish high-quality Hexagon Head Bolts, Clevis Bolts and Pins, Washer Head Screws, and Threaded Taper Pins.

Write for Catalog and Engineering Data

AERO SCREW COMPANY

19th Ave. at 12th St., Rockford, Illinois

Saving PRICELESS SECONDS . . . STRAIGHT DOWN THE LINE!



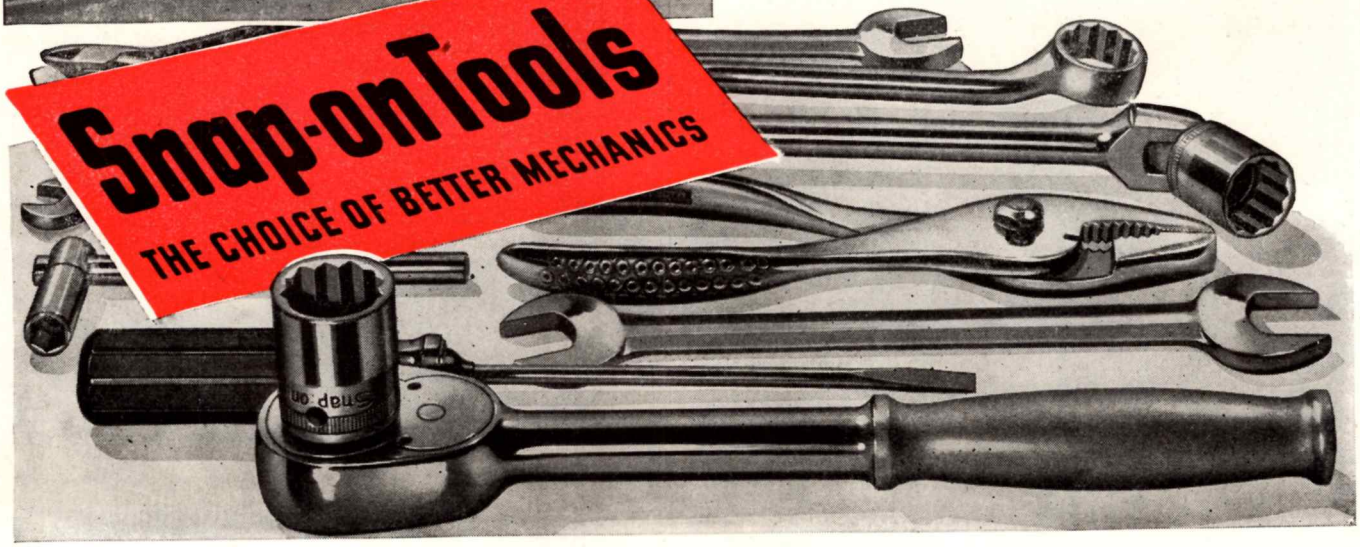
On every hand tool operation . . . *check and double check* . . . to make sure that the *right* tool, the *fastest* tool, is on the job. Worn tools, "slow tools" . . . tools poorly adapted to each specific application . . . waste time, skill, energy.

Straight down thousands of busy production and assembly lines Snap-on tools are the standout choice for speed, adaptability, accuracy. Their ease of application, solid grip and powerful leverage save time and energy, help promote a smooth, uninterrupted flow of work.

Eliminate the "bottle neckers" . . . replace with Snap-ons. 3000 modern Snap-on tools offer a wide selection for production and maintenance needs. Distributed through 35 factory branches located in key production centers. Write for catalog and address of nearest branch.

SNAP-ON TOOLS CORPORATION
8022-J 28th Avenue KENOSHA, WIS.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS



(*Continued from page 363*)

Borg-Warner Corp., Muskegon Heights plant, Muskegon Heights, Illinois.

Cannon Electric Development Co., Los Angeles, Calif.

Carborundum Co., Niagara Falls plant, Niagara Falls, N. Y.

Chicago Wheel & Mfg. Co., Chicago, Ill.

Continental Motors Corp., Aircraft Engine Div., Muskegon, Mich.

Delco-Remy Division, General Motors Corp., Anderson, Ind.

DeVilbiss Co., Toledo, Ohio.

Ethyl Corp., Deepwater plant, Deepwater, N. J.

Foote Bros., Gear & Machine Corp., Chicago, Ill.

Ladish Drop Forge Co., Cudahy, Wis.

Charles Lenning & Co., Inc., Bridesburg, Pa.

Metal Specialty Co., Cincinnati, Ohio.

Packard Electric division of General Motors, Warren, Ohio.

Pittsfield Works, General Electric Co., Pittsfield, Mass.

Poulsen & Nardon, Inc., Los Angeles, Calif.

Ritter Co., Inc., Rochester, N. Y.

Scott Aviation Corp., Lancaster, N. Y.

S. F. Bowser & Co., Inc., Fort Wayne, Ind.

Conn. Telephone & Electric Div., Great American Industries, Inc., Meriden, Conn

Edo Aircraft Corp., College Point, L. I., N. Y.

Handy & Harman Co., Bridgeport, Conn.

Macwhyte Co., Kenosha, Wis.

Mishawaka Plant, U. S. Rubber Co., New York City.

Solar Aircraft Co., San Diego,

South Bend Lathe Works, South Bend, Ind.

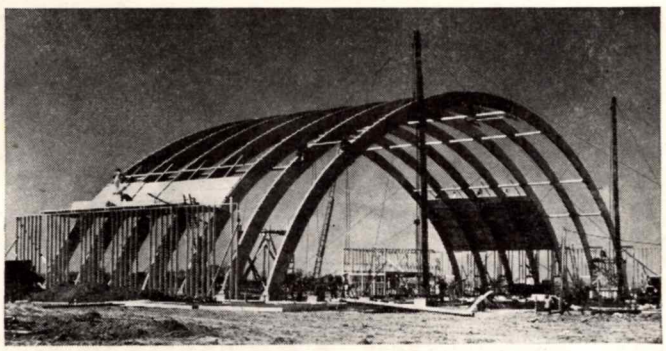
Wyman-Gordon Co., Worcester, Mass.

"Fortress in the Sky" Released by Boeing

"Fortress in the Sky", a three-reel sound film in technicolor saluting the Boeing *Flying Fortress* has been released this month by the company's public relations. Bookings are available to aviation training classes, service and civic organizations, college and senior high school classes, museums, engineering and all aviation-minded groups. It is a 16 mm film and runs for 30 minutes.

The film, photographed in Boeing plants and at an advanced Army Air base, relates a part of this bomber's role in the operations of our flying forces since Dec. 7, 1941.

Produced and distributed by the Princeton Film Center, Princeton, N. J., the film may be used by the borrower for fifty cents plus the cost of transportation charges to and from the distribution center to his company.



Laminated yellow pine arches measuring 170 ft across are used in the construction of the new wooden hangar at Fairchild's Hagerstown, Maryland, plant

Stow Mfg. Co., Binghamton, N. Y.

Taft-Peirce Mfg. Co., Woonsocket, R. I.

Wallace & Tiernan Products Inc., Belleville, N. J.

Westinghouse Electric & Mfg. Co., Meter Division, Pittsburgh, Pa.

Star Awards

Winning again the Army-Navy production award for meritorious services in war production, which constitutes the addition of a white star to the "E" flag, are the following companies:

Aluminum Industries, Inc., plant 1 and plant 2, Cincinnati, Ohio.

Bausch & Lomb Optical Co., Rochester, N. Y.

New Martin Cargo Plane

The patent on a new type of cargo airplane which will eliminate many of the problems of loading and unloading air freight has been granted to the Glenn L. Martin Co., by Willem D. Van Zelm of the company's engineer-

(*Continued on page 369*)

Our Chicago Warehouse has been designated by the War Production Board as a warehouse to distribute the aircraft materials listed below. They are for use in airplanes and available at our Chicago Warehouse only.

WD-X-4130 SHEETS

Open Hearth, Normalized, Pickled and Oiled to Spec. AN-QQ-S-685, Condition N. All gauges .016 to .50, sheets 18 x 72".

NE-8630 SHEETS

Open Hearth, Normalized, Pickled and Oiled to Spec. AN-S-12, Condition N.

STAINLESS STEEL BARS

Spec. AN-QQ-S-771.

STAINLESS SHEETS

Spec. AN-QQ-S-772.
Spec. AN-QQ-S-757.

Write, Phone or Wire, if you are eligible for these materials, to United States Steel Supply Company, P. O. Box MM, Chicago (90), Ill. Telephone BRUnswick 2000 —Teletype CG. 605.

Call us also for National Emergency Alloy Steels and General Purpose Steels

We welcome your inquiries for the new alloy steels which save critical materials needed for other war purposes. And, although our stocks of other steels, steel products, tools and machinery are not what we wish they were, we'll do all we can to fill your orders—subject, of course, to priority restrictions.

UNITED STATES STEEL SUPPLY COMPANY
USS STEELS
SERVICE

CHICAGO (90)
BRUnswick 2000 Teletype CG. 605
BALTIMORE (3)
GILmore 3100
BOSTON (34)
STAdium 9400 Teletype BRTN. 10
CLEVELAND (14)
HEnderson 5750 Teletype CV. 153
MILWAUKEE (1)
Mitchell 7500 Teletype MI. 587
NEWARK (1), N. J.
Bigelow 3-5920 REctor 2-6560
BErgen 3-1614 - Teletype NK. 74
PITTSBURGH (12)
CEdar 7780 Teletype PG. 475
ST. LOUIS (3)
MAin 5235 Teletype SL. 384
TWIN CITY - St. Paul (4)
NEstor 2821 Teletype STP. 154

UNITED STATES STEEL SUPPLY COMPANY
(formerly Scully Steel Products Company)

UNITED STATES STEEL

AMERFLEX

Reg. U. S. Pat. Off.

Tougher, Longer-Lasting

FLEXIBLE CONDUIT ASSEMBLIES

Development of a new technique for applying plastic tubing to metallic conduit and double-channeled ferruling have made possible the production of the new Amerflex *flexible* conduit assemblies. Tougher and longer-lasting, they stand up under the severest service conditions.

Three types of Amerflex assemblies—meeting every flexible conduit need—are now being manufactured: Type I—plain, uncovered flexible metallic conduit. Type II—synthetic-covered flexible metallic conduit. Type III—synthetic tubing with fittings, but without metallic base. Assemblies meet AN, AC, NAS and NAF specifications.

The Searle process permits the use of a thin, light, tough plastic tubing as a covering material. In the manufacture of Type II assemblies, the tubing is applied cold over the shielded conduit. Once in place, it contracts. The result—a continuous, firm grip on the metallic base... a smooth, even surface... closely held o. d. dimensions... free passage of assembly nuts... and a tight-fitting covering that is not weakened by flexing.

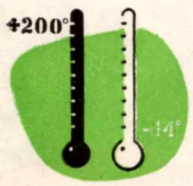
Our high-speed production enables us to handle orders of any size and to meet *your* production line emergencies. No order is too large or too small.

SEARLE AERO INDUSTRIES, INCORPORATED
ORANGE, CALIFORNIA

FACTS ABOUT AMERFLEX ASSEMBLIES

Wide Range of Sizes. Type I assemblies are made in any length, and inside diameters of 3/16" to 2½". Type II are made in lengths up to 50' and inside diameters of 3/16" to 1¼". Type III are made in any length and inside diameters of 3/16" to 2".

Transparent, Opaque, Colored. The plastic tubing used in the production of Amerflex covered conduit assemblies comes in opaque, transparent and standard colors—black, green, yellow, red, blue, obtainable on special order.

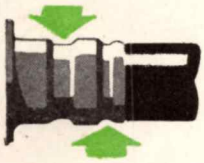


Withstands Temperature Changes. Amerflex plastic tubing, opaque, will withstand continuous temperatures of 200°F. and remains pliable at —40°F. The transparent covering will withstand continuous temperatures of 188°F., and remains pliable at —64°F.

Not Weakened by Flexing. The method of applying Amerflex plastic causes it to contract onto the webbed surface of the shielded conduit. Flexing does not weaken the plastic material, or disturb its continuous, even grip on its metallic base. Neither does it cause it to pull away from the ferrules.

Holds Close Tolerances. Because Amerflex plastic covering is applied "cold," and is not extruded or wrapped on, it holds wall tolerances of .005; assures uniform o.d. dimensions and a smooth, even surface. This means free passage of assembly nuts, eliminates binding.

Saves Weight. The method of manufacturing Amerflex assemblies makes it possible to use a thinner, lighter and more uniform plastic tubing that provides full protection against abrasion, moisture and chemicals at a substantial saving in weight.



Exceeds Pull Test. Double-channeling, done by specially designed machines, provides (1) a moisture-proof seal, and (2) a strong, continuous grip that exceeds pull test specifications. This assures more durable and dependable conduit assemblies.

Type III is Exclusive. The patented process by which ferrules are affixed to the plastic conduit, in the production of Type III assemblies, gives us a product that has not yet been duplicated. It offers unlimited possibilities in saving conduit weight in aircraft.

Searle Conduit Assembly Service Plan

1. Prevents waste due to engineering changes.
2. Reduces your conduit assembly inventories.
3. Lowers your conduit assembly costs.
4. Reduces your scrap by eliminating rejects.
5. Eliminates possible conduit bottlenecks.
6. Frees your manpower for other jobs.
7. Releases valuable factory space for more profitable operations.

Frequent changes in aircraft design and specifications are repeatedly catching aircraft manufacturers with large inventories of conduit assemblies made obsolete by the changes. To provide a relief for this situation, we have developed the "Searle Conduit Assembly Service Plan."

Under this plan, unused and undamaged assemblies—made by us and rendered inactive by engineering changes—can be returned, for which we will pass on to you a credit of 75 per cent of the purchase price to apply against your subsequent Amerflex replacement order. This will reduce to the minimum losses you can suffer from design changes. In the event you are making your own assemblies, it will free manpower for other and more profitable operations.

We are in position to offer this service plan, because our high-speed production permits us to parallel your rate of production on any given model plane, thereby enabling you to carry a minimum inventory of conduit assemblies at all times. Your required assemblies for any month can be delivered 10 days before the due date, or as near that time as transportation facilities will permit.

At your request a Searle representative will call to discuss our service plan with you. We also invite you to submit your engineering requirements.

MILLIONS

on the World's Fighting Fronts

We modestly say that *millions* of NICE *precision* Aircraft Bearings assure our warplanes that essential battle element—SPLIT-SECOND CONTROL.

And our pledge to those who build them and to the men who fly them is a pledge of UNINTERRUPTED PRODUCTION—until UNCONDITIONAL SURRENDER!

NICE

NICE *Aircraft Bearings*

NICETOWN PHILADELPHIA PENNSYLVANIA

Manufacturers of Precision and Commercial Ball Bearings

(*Continued from page* 365)
ing department, designer of the craft.

The features of the plane include a collapsible ramp which can run either to the ground or the back platform of a truck; built-in winches for dragging heavy freight on board; adjustable jacks which prevent any strain on the plane itself, and a loading door under the boom extended tail surfaces.

Designs for the aircraft as yet have no weight limitations nor maximum size.

Add to July Directory

In the ninth Annual Directory of Aircraft and Engine Materials compiled in July, AERO DIGEST listed up-to-the-minute information as to the prime sources of supply of aircraft materials. This was offered as a contribution to the production speed-up. Regrettably the following companies were not named. For your information and convenience we suggest that you clip the following company names and paste it to your July list:

STEEL
(and Steel Alloys)

Wire and Cable
Macwhyte Co.
2907 14th Ave., Kenosha, Wis.

PROTECTIVE COATINGS
(For Metals)

Bell Co., Inc.
411-15 No. Wolcott, Chicago, Ill.

Army Cancels "Caravan" Contracts

Orders for manufacture of the C-76 *Caravan*, wooden cargo plane, have been cancelled by the Army and have been replaced with similar orders for the C-46 *Commando* metal plane. The War Department notified contractors Andrew J. Higgins of New Orleans and the Curtiss-Wright Louisville plant of the substitution, causing little or no displacement of workers.

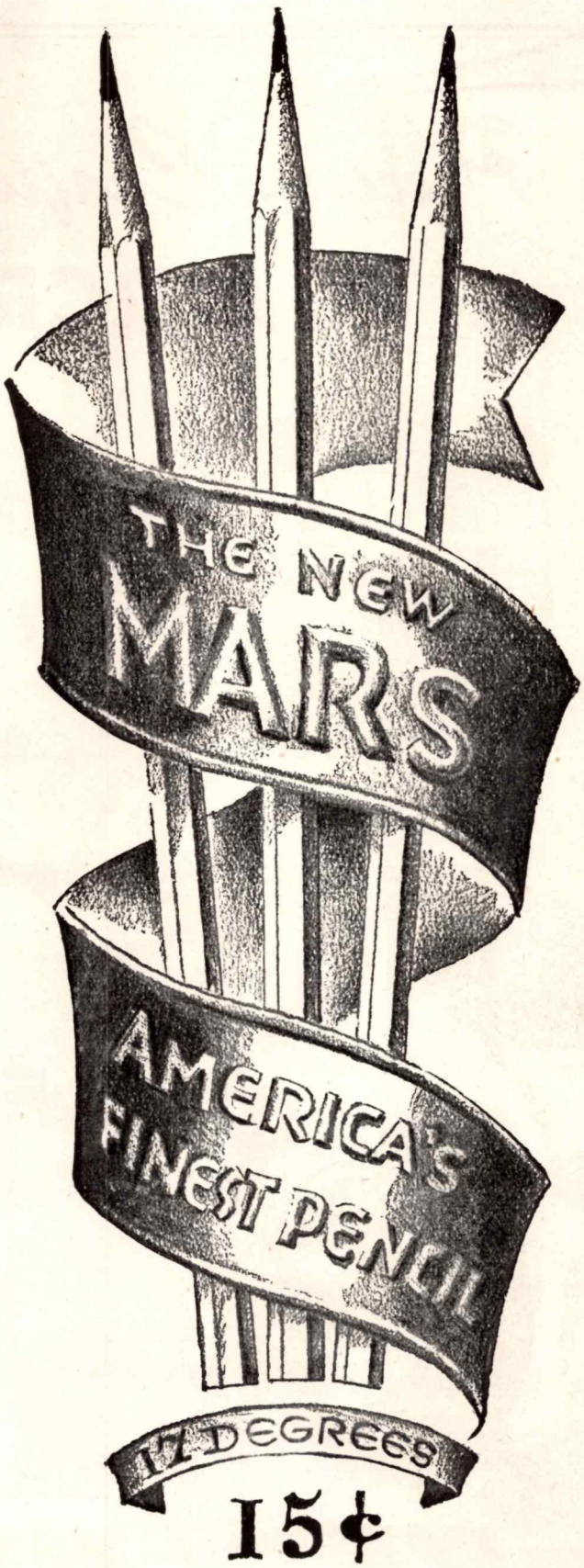
Resumption of production of the *Commando* began after the announcement that experience with models of the *Caravan* had demonstrated that it was both more costly to build and less efficient than the metal airplane. When orders were placed last year, the shortage of necessary materials, mainly aluminum, was a deciding factor that the wooden planes go under construction. It was also thought at that time that the short-haul *Caravans*, designed to operate from small and unimproved landing field, would be greatly utilized. Since then an increased need for long-range *Commandos* as well as an increase in the production of aluminum has developed.

SAE Discusses Future Cargo Planes

Engineering plans for post-war air cargo development highlighted the program of the West Coast transportation and maintenance meeting of the Society of Automotive Engineers recently in San Francisco. Projected developments in fuels and lubricants, motor freight handling and distribution under wartime and post-war conditions were included in round-table discussions. Wartime use of tires and the requirements of air cargo planes comprised an important part of the program.

At one forum J. B. Kendrick, chief aerodynamics and flight engineer of Vega Aircraft Corp., opened a session on the subject of air cargo planes, engineering viewpoint, while Thomas Wolfe, vice-president in charge of traffic, of Western Air Lines, closed with air cargo planes, operator's viewpoint.

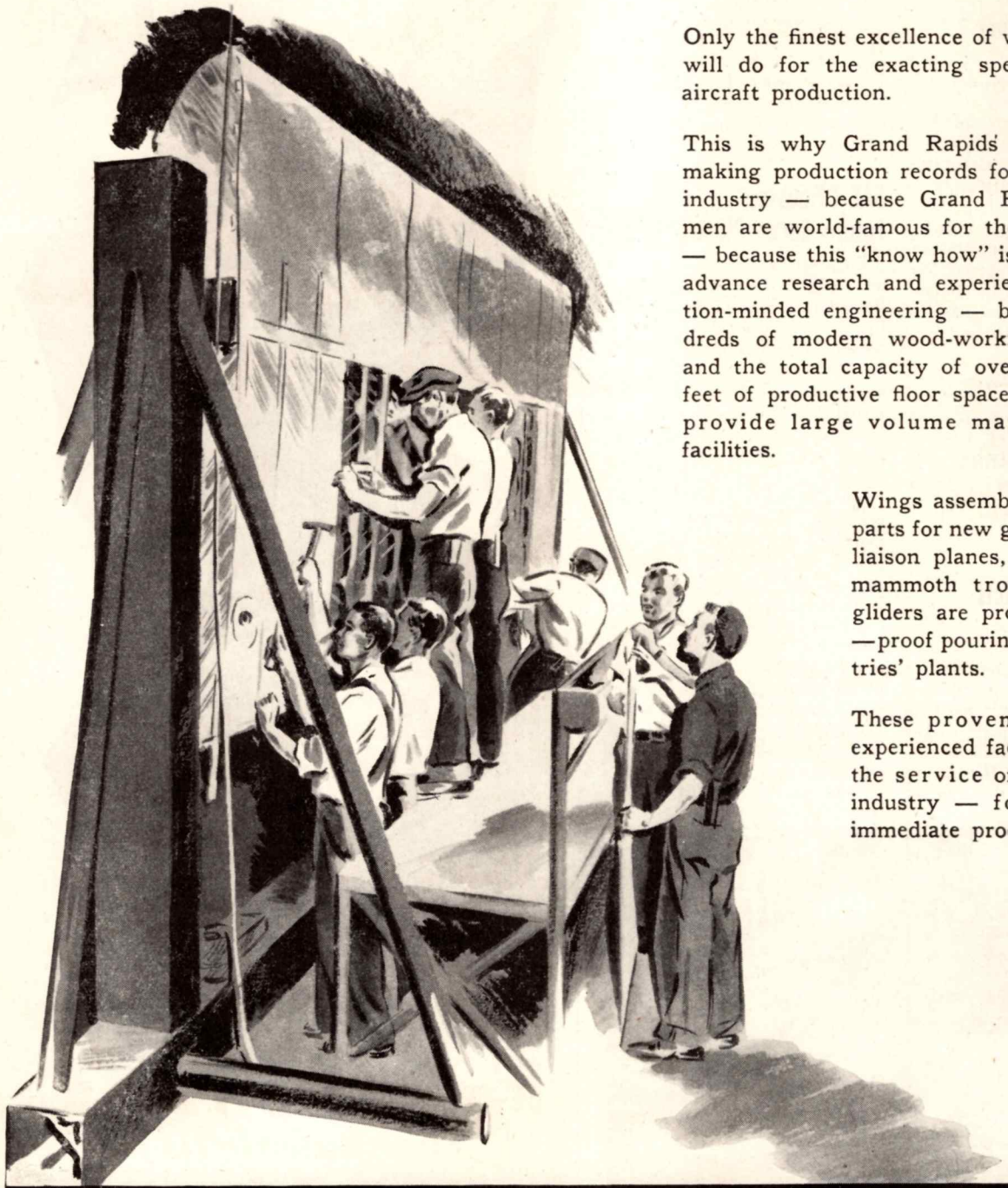
Truck with Baker center control moves another Ranger "12" engine into the shipping line. These engines are wrapped in moisture-repellent Pliofilm for shipment



"DEMAND THE BEST!"

J. S. STAEDTLER, INC.
53-55 WORTH STREET
NEW YORK, N.Y

Precision Craftsmanship in WOOD for the AIRCRAFT Industry



Only the finest excellence of wood-working will do for the exacting specifications of aircraft production.

This is why Grand Rapids Industries is making production records for the aircraft industry — because Grand Rapids craftsmen are world-famous for their excellence — because this "know how" is backed with advance research and experienced production-minded engineering — because hundreds of modern wood-working machines and the total capacity of over 2½ million feet of productive floor space of 15 plants provide large volume manufacturing facilities.

Wings assemblies, precision parts for new giant bombers, liaison planes, trainers, and mammoth troop-carrying gliders are proof in the air —proof pouring from Industries' plants.

These proven skills, these experienced facilities, are at the service of the aviation industry — for available immediate production.

GRAND RAPIDS INDUSTRIES, INC.

MONUMENT SQUARE BUILDING · GRAND RAPIDS, MICHIGAN

15 Plants Famous for Fine Furniture United in Production for the Aircraft Industry

Distributors Form Association

The Aviation Distributors and Manufacturers Assn. has been formally adopted as the organization of the distributors of aviation parts, supplies and equipment. The constitution and by-laws have provided for the creation of separate distributors and manufacturers divisions.

The initial annual meeting will be held Dec. 1, 2, 3 in St. Louis, Mo.

The need for such a group was cited last fall when WPB officials met with the distributors in Washington and it was noted that the aviation men were without representation for business contacts with the Government. Subsequent meetings of the distributors have followed and the formal association organized.

Temporary officials elected were Ray Snyder, Synder Aircraft Corp., president; W. F. Scott, Jr., Supply Division, Inc., vice-president; G. B. Van Dusen, Van Dusen Aircraft Supplies; L. G. Mason, Aviation Supply Corp.; R. V. Trader, Bob Trader Aero Supply and A. W. Whitaker, Portland, Ore., all directors.

U. S. Chamber Considers Post-War Air Policy

The United States Chamber of Commerce has moved into the picture on post-war international transportation and has appointed a special committee of experts in sea and air shipping and travel to consider the problems which are expected in making permanent the world-wide system now operated under military supervision. The results of the research of the committee will be used as a basis for forming a national policy to be proposed by the chamber.

Chairman of the committee is Chamber Vice-President William K. Jackson of the United Fruit Co.

Eric A. Johnston, president of the USCC, said that the committee was selected to point up the viewpoints of the using public as well as the suppliers of international transport. Its report will not only assist the administration of transportation by the government but also will aid Congress in the final say in adopting the national policies.

Johnston told the committee that communications by sea and air with all parts of the world will in the future be, more than ever, essential to our national well-being. He cited the "bitter and expensive experience" resulting from our inadequate ocean shipping.

20 Years Ago

From the 1923 Issues of AERO DIGEST

January

To organize an airline from Paris to New York in the near future, with six intervening landing spots made up of floating island stations by the use of former German ships—such is the project of Capt. Charles Nungesser, French war ace, and now constructor of airplanes.

★ ★ ★

February

The Japanese budget for the present fiscal year includes an appropriation for military and naval aeronautics of approximately $21,000,000, 76% of the total appropriation for the U. S. Army and Navy Services for the current fiscal year.

★ ★ ★

February

It is a certainty that in the near future, business men will find the use of the airship more convenient than the use of the steamship at a relatively limited cost, saving three-quarters of the time and eliminating the usual discomforts of seasickness.

★ ★ ★

March

Henry Ford says: "We are standing on the threshold of a new phase of transportation. There is no doubt of the continued development in the navigation of the 'air ocean', and such development will far surpass in rapid service any other means of transportation on land or water."

★ ★ ★

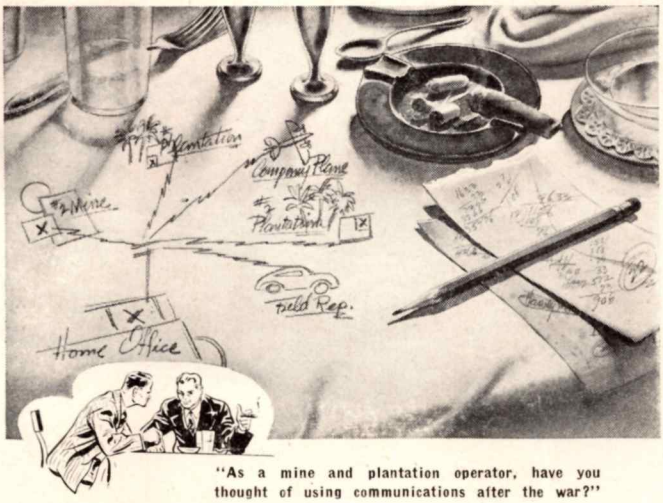
March

McCook Field authorities claim to have perfected an instrument that enables aviators, while flying, to talk to persons on the ground.

★ ★ ★

January

For a Nation to maintain a commercial supremacy, it must have a complete Air Service inland, and to all countries of the world. Otherwise its exports will be minimized and secured by the producing countries operating such an air service.



"As a mine and plantation operator, have you thought of using communications after the war?"

"Tablecloth" Communications

. . . or just plain pencil doodlin'—perhaps—and no doubt you've been doing some yourself, planning for post-war operations in your own business.

Our job right now is making specialized communications equipment for our government; and what we're learning now will be of utmost value to communications in YOUR business, post-war and after.

Since infinite peacetime applications come from the stimulation of war—YOUR communications equipment will be BETTER than ever. Better in design, lighter in weight and more compact through skilled manufacturing.

Here we have done a bit of doodlin' for applications in a mine and plantation setup. Future "Tablecloth Communications" will dramatize possible uses of Harvey-Wells equipment in industries, transportation, lumbering and other allied fields.

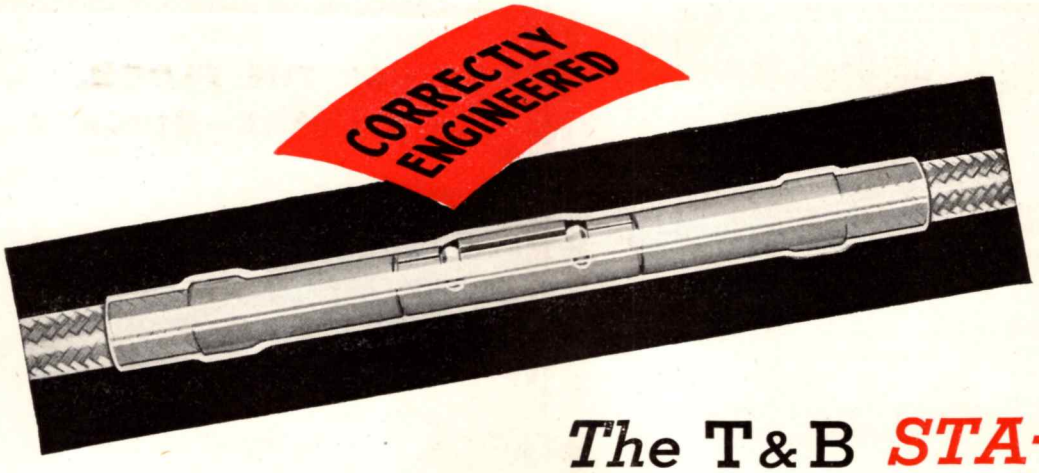
HARVEY-WELLS *Communications inc.*

★

HEADQUARTERS

For Specialized Radio Communications Equipment

SOUTHBRIDGE, MASS.



The T&B *STA-KON*

DISCONNECT SPLICER

Quick Facts for the Critical Aircraft Engineer

Made for wire sizes No. 22 through No. 10 Aircraft. Designed for the quick connecting and disconnecting of aircraft wiring, either at time of assembly, or when in service. ¶ Strong, lightweight, highly conductive. ¶ Approved. ¶ Can be connected or disconnected countless times without impairing its electrical or mechanical characteristics. ¶ Disconnects at approximately 15 pounds pull. ¶ Because both tips are identical, there can be no confusion in assembling. ¶ Being solderless, this T & B Splicer installs fast with regular Sta-Kon Pressure Tools. ¶ Synthetic sleeves, solid black or transparent, are available. ¶ Insulators are light weight, very flexible, and possess high dielectric and mechanical strength.

PATENT PENDING

The dependability of the Disconnect Splicer under severe service conditions is due to its slotted coupler section—a high tension alloy spring. Due to the pressure of this essential spring, tips are in firm, constant wide-area contact.

SOLD ONLY THROUGH RECOGNIZED T & B ELECTRICAL WHOLESALERS

Send for newly revised Aircraft Catalog No. 36 for full technical data on equipment designed for the Aircraft industry.

THE THOMAS & BETTS CO.
INCORPORATED
MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899
ELIZABETH 1, NEW JERSEY
In Canada: Thomas & Betts Ltd. Montreal

AT THE AIRPORTS

U. S. Will Need 20,000 Airports Says Randolph

More than 500 mayors, members of airport committees and engineers from the Midwest and Canada attended the recent air conference held at St. Paul, Minn., under the auspices of the NAA. The post-war role of airports and pilots was discussed and a vast peacetime expansion of commercial aviation was forecast, indicating the need for 20,000 airports and air terminals, according to Rep. Jennings Randolph of West Virginia. He said a city without one or more airports would find itself a place on "the side streets of progress."

Charles I. Stanton, civil aeronautics administrator, declared that Federal grants for the construction of more airports after the war might be patterned along the lines of government aid to the states in building roads. He said that Federal airport authorities should maintain control of national planning yet local problems must be declared within the States.

Another highlight of the program was the estimation by R. McLean Stewart, executive director of the war training service of the CAA, that civil aviation must be ready to train 100,000 fliers a year after the war because wartime pilots within a year or two afterward will be over-age for the work.

Stewart stated that expenditures amounting to $89,000,000 are to be made by the CAA this year on its training program for civilian aviation, as compared to $72,677,000 spent last year. The CAA's latest weekly report showed 27,746 men assigned to flight training with flight and ground school contractors employing 9065 persons and utilizing 6978 airplanes.

Santa Fe Airport

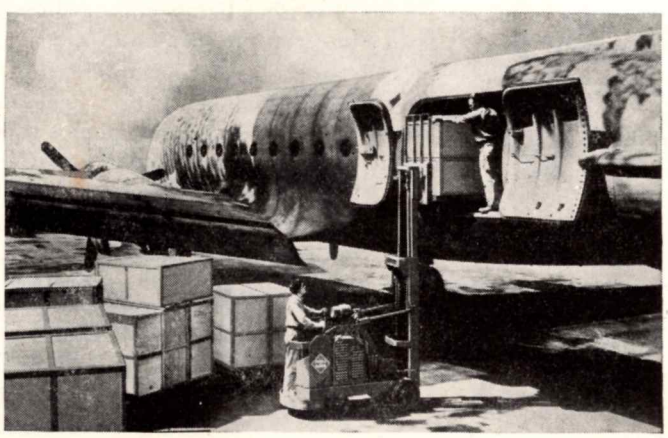
The official opening of Santa Fe's new airport, located about five miles west of the old field, marked the resumption of regular airline passenger service to New Mexico's capital. At the same time Continental Air Lines dedicated a new air terminal there, following the city's traditional Spanish pueblo style of architecture and expanding facilities for passenger work and airline operations. The CAA occupies offices in the building.

Dallas to Expand Love Field

City officials of Dallas, Tex., are preparing to spend nearly $200,000 and at the same time enlist Federal aid on property to enlarge Love Field. Runways will be extended and two principal runways will be resurfaced with concrete among improvements. Better traffic facilities to downtown Dallas are included in the plans. The additional property will be given to the War Department for use during the emergency as part of the aviation expansion program.

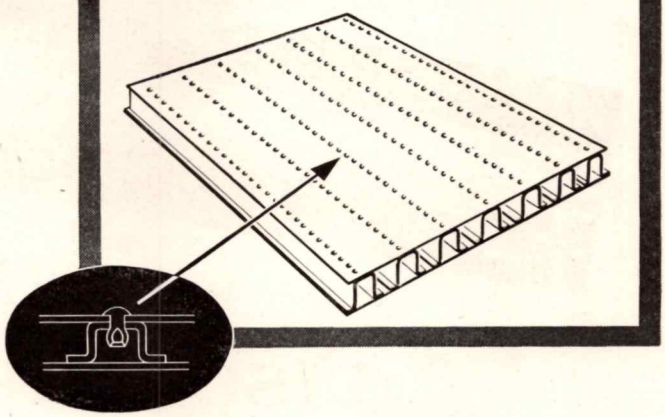
Smith Reynolds Port

Construction has begun on an improvement project at Smith Reynolds Airport, Winston-Salem, N. C., which will cost between $750,000 and $1,000,000. The job which will be completed in approximately four months, will include construction of four runways. The airport is under Army contract.



A "Skymaster" gets its cargo in the modern manner. This new method of loading enables two men to raise or lower a half-ton of freight and reduces ground time from hours to minutes. The lift truck is an Elwell-Parker

"ANCHORING" THE FLOOR OF A PLANE—*QUICKLY*



Another typical job for Explosive Rivets

Here's blind riveting at high speed. When a floor skin is in position and drilled, Du Pont Explosive Rivets provide the quickest method of securing the skin to the ribs of the frame.

The job is simplicity itself. Alone, one operator using only one tool—a Du Pont Riveting Iron—can readily set from 10 to 20 Explosive Rivets per minute.

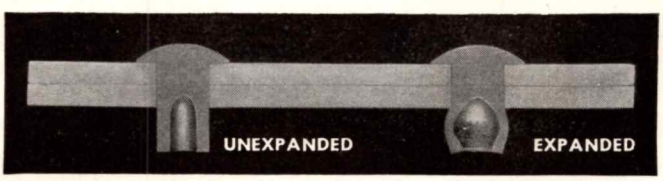
One easy operation does it. Tip of iron is applied to rivet heads. Heat detonates a tiny charge in the end of the rivet. Expansion forms a blind head that sets the rivet securely in place. And the solid shank of the Explosive Rivet as shown in the detail sketch, gives strength where it's needed for a trouble-free job.

Check this new, faster way of blind riveting. It speeds production, reduces costs and gives you a better job. Write for booklet, "How to Use Explosive Rivets." E. I. du Pont de Nemours & Co. (Inc.), Explosives Dept., 5494-L Nemours Bldg., Wilmington, Del.—5-236-L General Motors Bldg., Detroit, Mich.—5801-L So. Broadway, Los Angeles, Calif.

DU PONT
REG. U. S. PAT. OFF.

EXPLOSIVE RIVETS

The one-piece blind fastener with a solid shank



HOW WESTINGHOUSE SERVES THE AVIATION INDUSTRY

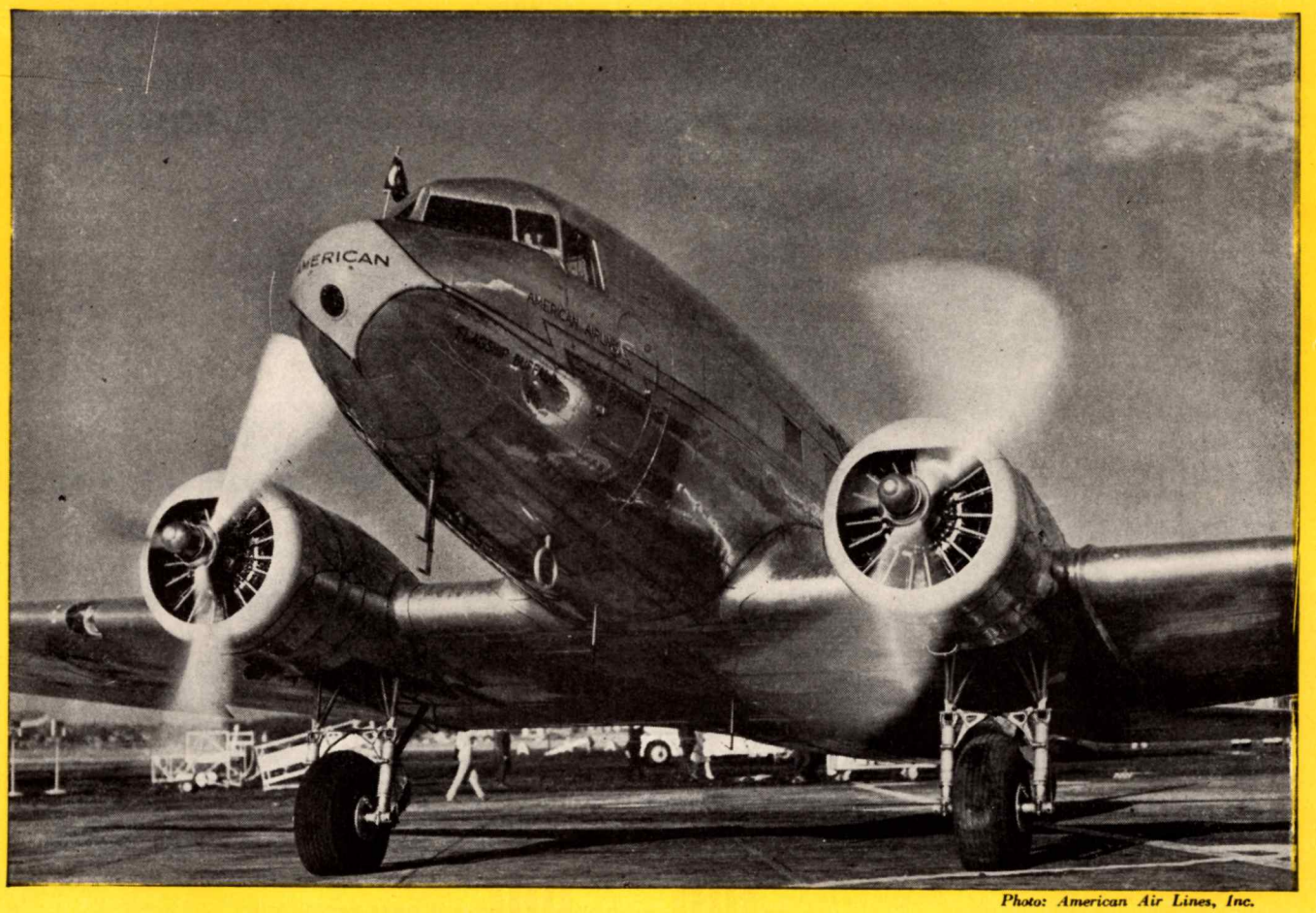
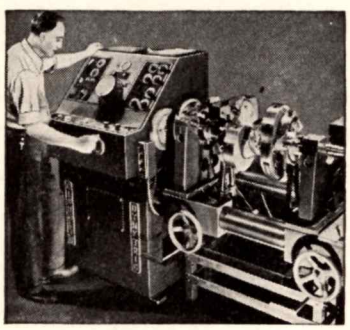


Photo: American Air Lines, Inc.

SMOOTHING THE PROP

SO THAT PLANES CAN FLY FASTER, CLIMB HIGHER



Balancing a crankshaft on a Dynetric Balancing Machine. Detecting and correcting minute vibrations before they can do damage is a vital step toward eliminating crankshaft and piston wear, lengthening the engine's service life.

Eliminate vibration from a plane, and you go a long way toward increasing its efficiency—open new avenues for more speed, and higher altitudes.

But to locate the sources of minute vibrations is quite a problem. Some, originating from engine and propeller unbalance, measure less than .0005 of an inch, yet may become destructive at high speeds.

Westinghouse, working with a machine tool manufacturer, developed the first successful electronic method of detecting such vibration . . . the Dynetric Balancing Machine. Through the magic of electronics, this machine locates and measures unbalance vibrations as small as *twenty-five millionths* of an inch . . . and does it in seconds.

First used by engine, electric motor, and super-charger manufacturers to balance rotating parts, dynetric balancing is now being applied to the production of aircraft propellers. Under conditions duplicating actual flight, vibrations are found, measured and eliminated — enabling the manufacturer to supply propellers that will rotate in perfect balance, regardless of speed or prop-pitch.

Still another aviation application is the dynetric balancing of wheel and tire assemblies—to help planes take off faster, land more safely.

★ ★ ★

These applications are examples of how Westinghouse research is helping the Aviation Industry. Our engineers are ready to work with you to meet specific problems involving the application of electric power. Phone your nearest Westinghouse office. Or write Westinghouse Elec. & Mfg. Co., Dept. 7-N, East Pittsburgh, Pa.

J-94569

Westinghouse

PLANTS IN 25 CITIES... OFFICES EVERYWHERE

plane talk

ELECTRICAL DEVELOPMENTS, IDEAS, APPLICATIONS FOR THE AVIATION INDUSTRY

A MIDGET SEARCHLIGHT, visible for 60 miles, is a dramatic new development of Westinghouse. Designed to help rescue fliers forced down at sea, this tiny light is slipped on the head, leaving both hands free. Powered by a hand-cranked generator included in each life raft, its 1,500 candlepower beam can be seen 60 nautical miles away. The lamp has a life span of 10 nights, when burned all night; is trigger-equipped for signaling.

★ ★ ★ ★

A 65,000 RPM MOTOR for high-speed finishing of small aircraft parts has just been perfected in our laboratory. Designed for direct drive of the spindle, it provides the high grinding-wheel speeds necessary for finishing fractional-inch parts. Results: complicated belt or pulley drives are eliminated; maintenance is reduced; the accuracy and finish of small parts improved.

★ ★ ★ ★

A COORDINATED DEVELOPMENT PROGRAM on stall warning indicators is being carried on by Westinghouse for the Civil Aeronautics Administration. By means of these devices, a pilot will receive warning when his ship is approaching a stall condition.

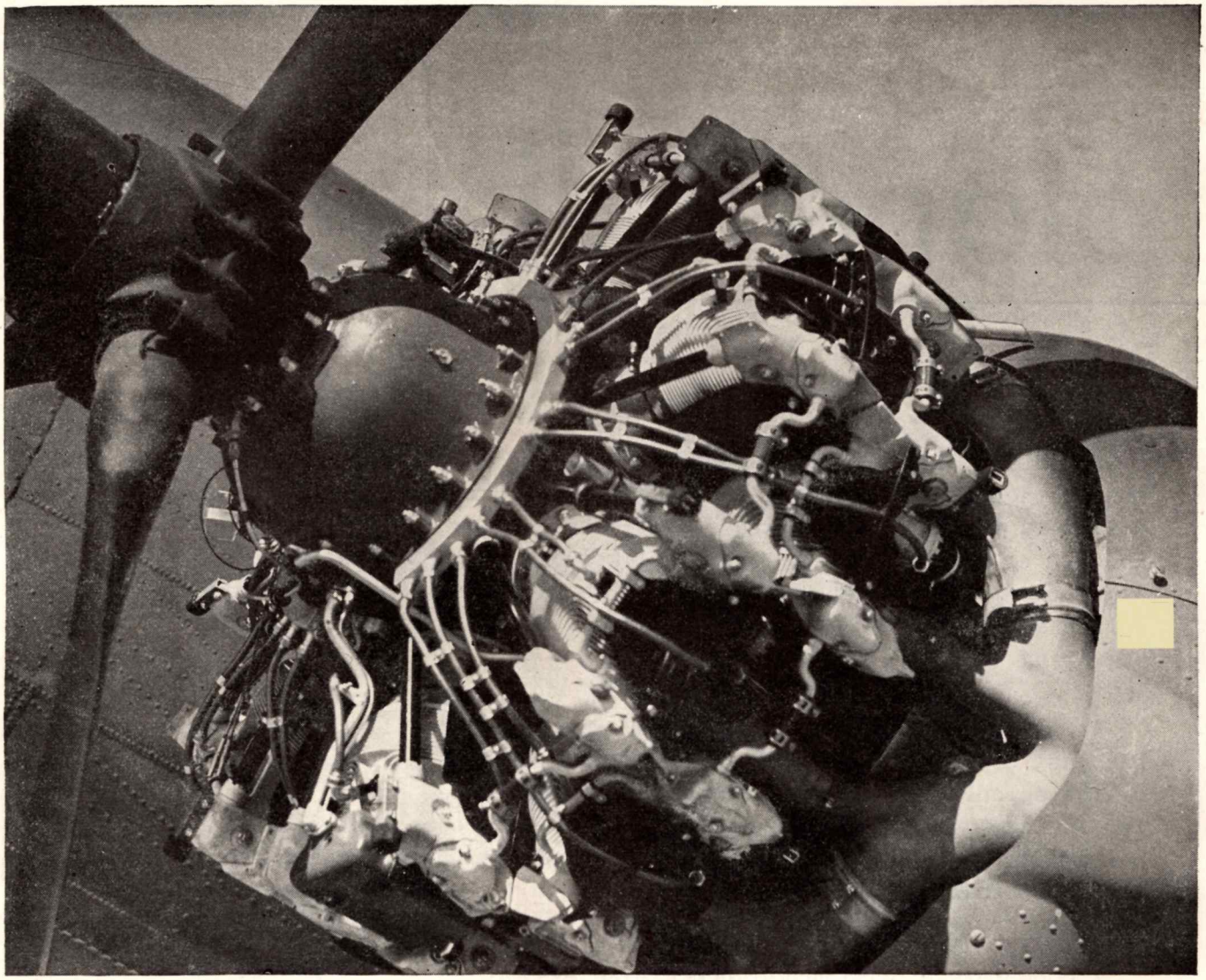
★ ★ ★ ★

NAVY ACROBATIC TRAINERS, pictured recently in Life Magazine, are equipped with Westinghouse control systems. One novel one teaches student pilots to depend on their safety belts when making rolls, loops, banks and turns. The control uses a simple, reliable adjustable-voltage scheme without magnetic relays or contactors.

★ ★ ★ ★

A NEW TORQUE METER, designed to give engine output in direct reading, will soon enable pilots to see when their engines have been adjusted for maximum power output. Laboratory results to date indicate that this instrument will soon be practical.

Westinghouse



over Burma or Berlin
"Stainless" handles the tough jobs

After more than 18 months of war, stainless steel stands out as the only metal that holds its own in the punishing exhaust systems of high-powered warplanes. One of these rustless alloys that is being war-proved on every battlefront is ARMCO Stainless.

This is why ARMCO Stainless must be Spartan-tough. In endless hours of combat flying, red-hot corrosive gases roar through the stainless steel collector systems of big bombers and speedy fighters. The great vibrating engines would tear ordinary materials to pieces, yet this heat-resisting metal takes it all and comes back for more.

You'll approve these other advantages of ARMCO Stainless Steels too: They form easily and can be fabricated by the fast spot-welding process. The strength-weight ratio is exceptionally high. No heat treatment is needed to develop exceptional physical properties.

If you make planes or parts for the Allies' air armadas — or if you are thinking of future structural uses for metal—consider using ARMCO Stainless Steels. There is a grade for every requirement. Write to The American Rolling Mill Company, 2361 Curtis Street, Middletown, Ohio.

ARMCO STAINLESS STEEL

THE AMERICAN ROLLING MILL COMPANY

FINANCIAL BRIEFS

Semi-Annual Reports

BENDIX

For the six months ended Mar. 31 Bendix Aviation Corp. had a gain of 145% over the corresponding period in 1942 in net sales and other income. Total income amounted to $417,812,579 as compared with $170,420,270 in 1942. Net income at Mar. 31, 1942 was $8,190,449, the equivalent to $3.87 a share, common stock, against $8,122,679, or $3.84 a share the previous year. Provided for Federal taxes and estimated price adjustments was $100,515,431 against $36,261,381 in the 1942 period.

CHRYSLER

The Chrysler Corp. reported a net profit of $12,537,350, equal to $2.88 a share on 4,351,132 capital shares, for the first half of 1943, as compared with $8,770,006, equal to $2.02 a share, for the same period in 1942.

The 1943 profit provided for $25,450,000 Federal income and excess profits taxes and $6,000,000 for general post-war rehabilitation. Federal taxes in 1942 were $9,350,000. Profit for the second quarter of 1943 was $6,200,252 or $1.41 a share, after $13,600,000 taxes and post-war reserves of $3,000,000, as compared with $3,870,773 or $.89 a share, after $6,100,000 taxes in the second quarter of 1942.

Net sales for the six months totaled $435,405,318 against $259,250,081 last year. Cash and special deposits on Government contracts amounted to $140,804,937 on June 30 when advances on Government contracts totaled $46,087,452 of which $18,819,207 was in special deposits to be used exclusively for the financing of certain war projects. Inventories at that date amounted to $57,989,645.

Assets at mid-year were $305,687,382 against $259,588,078 at the end of 1942, and current liabilities were $145,886,997 compared with $118,217,426. Earned surplus totaled $135,987,458 against $129,976,806 at the end of 1942.

GOODYEAR TIRE & RUBBER

Goodyear Tire & Rubber Co., reports a volume of war production for the first six months of 1943 twice that for the same period in 1942. Net sales as of June 30, 1943 amounted to $366,269,545. Net profits for the period totaled $7,348,529, equal to 2 percent on the expanded net sales or $2.82 per share of outstanding common stock. This compares with the first six months of 1942 with net sales of $179,755,599 and net profits which were reported as $4,123,961 or $1.24 per share.

A reserve of $7,999,612 have been set up for the post-war rehabilitation of plants and equipment, property adjustments and other contingencies. The net working capital increased from $111,890,781 a year ago to $130,940,387 at the end of June, 1942.

LINK-BELT

For the six months ended June 30, the Link-Belt Co., reported a net income of $1,181,216 or $1.53 a common share. This compares with $1,019,578, equal to $1.32 a share of common stock, for the same period last year.

LYCOMING

The dollar volume of production of aircraft engines by the Lycoming Division of the Aviation Corp., during the first six months of 1943 increased 32% more than that of the corresponding period of 1942. Lycoming's backlog of orders is now approximately 15% greater.

PACKARD

Net earnings of the Packard Motor Car Co. for the first half of 1943 amounted to $1,974,489 after provision of $9,913,411 for normal income and surtax, and excess profits taxes, nearly double the annual business of its greatest peacetime year. For the same period in 1942, earnings totaled $3,966,151; however such figures did not reflect proportionate excess profits taxes or provision for contract renegotiations and deferment of these 1942 adjustments until later in the year which accounts for the decrease in earnings shown by the current comparison.

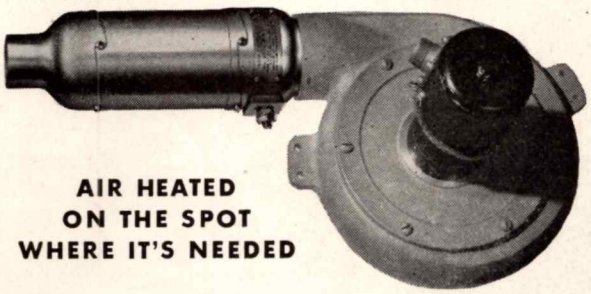
Increased production of Rolls-Royce engines for aircraft and Packard marine engines for PT boats for the half year represented shipments of $160,622,308 as compared with shipments in the same period last year of $86,435,663. Profits before taxes for the first six months of 1943 totaled $11,887,900 against $7,260,976 for the same period in 1942.

Unfilled orders on the company's books amounted to $960,000,000 as of July 1, 1943.

REYNOLDS METALS

For the six months ended June 30 the consolidated net earnings of Reynolds Metals Co., aggregated $1,906,348, equal to $1.75 a share on 1,023,662 shares

(*Continued on page* 379)



AIR HEATED
ON THE SPOT
WHERE IT'S NEEDED

NEW AIRCRAFT HEATER WITHOUT EXTENSIVE DUCTS

Warm air where you want it—with no dependence on engine heat and no extensive use of ducts. Attach this Avia Electric Aircraft Heater to an electric blower or ram air duct and get 600 to 6,000 B. T. U.'s per hour (depending on the specific application). Perfect for defrosting bomb sight windows, gun sighting windows, navigation dome, or side blisters. And for warming the bomb sight, gyro intruments, battery compartment, and turret mechanisms. Light weight plus rugged construction to withstand the most severe aircraft service. Can be designed for any specific application. Part #3005, 24-28 volts D.C.

Kindly use your firm letterhead when requesting the new Avia Electrical Aircraft Manual. Address Dept. AD-9.

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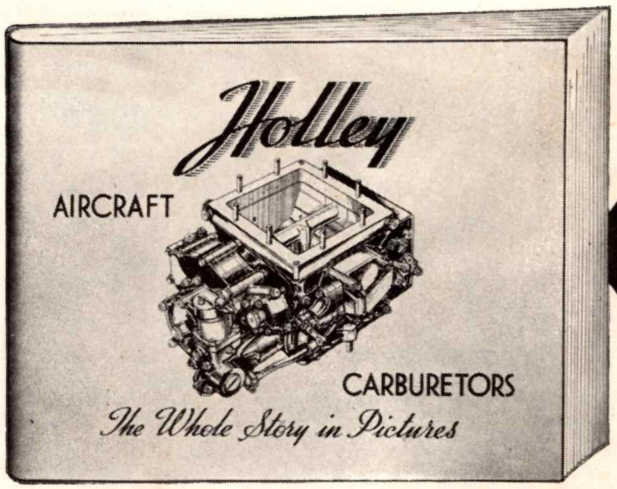

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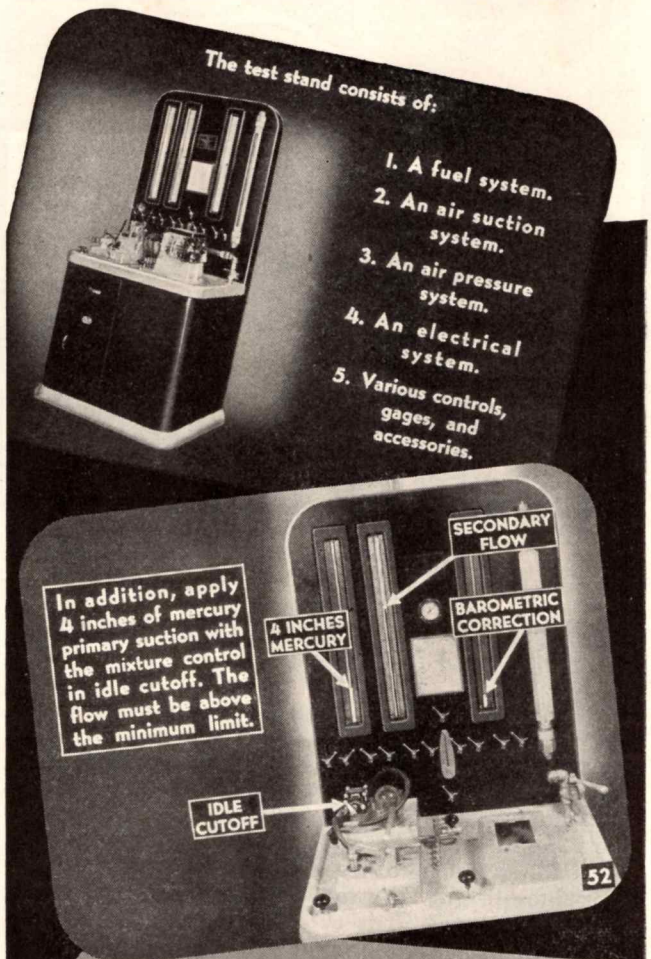

To supplement our new series of slide films on Holley Carburetor operation and service, we announce a new, 96-page Slide Film Review Book, for individual instruction, available for immediate distribution.

This new instruction book will enable any mechanic to study, operate and service Holley Aircraft Carburetors in the most efficient manner. The arrangement of the material permits thorough study and easy reference.

The book contains more than 800 carefully captioned illustrations, and is already being used to advantage by many training centers. Price, $1.00 a copy. Special quantity prices on request.

Write for your copy today.

HOLLEY CARBURETOR COMPANY

DETROIT, MICH.

HOLLEY AVIATION CARBURETORS

(*Continued from page* 377)
of common stock, after Federal income and excess profits taxes of $6,364,200 and special 5-year amortization of its war facilities amounting to $1,998,505. This compares with the net income of the same period in 1942 which amounted to $756,884 after Federal income and excess profits taxes of $1,346,000 and $1,382,000 special amortization, equal to 61 cents a share.

1943 earnings are subject to renegotiation of government contracts.

SPENCER HEATER

The Spencer Heater Division of the Aviation Corp. reported an increase in production of 50% during the first half of this year judging by gross sales as compared to the corresponding period last year. It was also stated that the total of unfilled orders is more than three times the amount at this date a year ago. Subcontracting work was 14% greater than it was at this same time in 1942.

UNITED AIRCRAFT

Shipments for the first six months of 1943 announced by United Aircraft Corp., amounted to $333,798,454.50 and net profits were $8,120,912.90 or $2.81 per share of common stock, after provision for dividends on preferred stock. Shipments of the corporation for the quarter ended June 30 totaled $174,628,901.48 with net profit amounting to $4,070,-163.25, the equivalent to $1.41 per share of common stock on 2,656,701 shares outstanding, after provisions for dividends to that date on preferred stock.

Braniff Votes Stock Increase

Stockholders of Braniff Airways, Inc., have voted a stock increase to promote a $5,000,000 expansion program of domestic routes and establishment of foreign routes. Common stock will be increased from 400,000 shares at $2.50 par value each to 1,500,-000 shares.

According to President T. E. Braniff the amount of additional capital funds is more than announced because the stock is to be sold at "market value" with the exception of 500,000 shares which will be issued as needed.

ABOUT PEOPLE

DONALD M. STUART has been appointed chief of the technical development division of the CAA and in this capacity will have charge of CAA experimental work on aircraft, radio and other projects important to wartime and post-war aviation. With the Bureau of Air Commerce since 1934, his last position was that of chief airways inspector.

ALFRED M. WILSON has been elected a vice-president of Minneapolis-Honeywell Regulator Co., having served as assistant to the president since joining the organization in August 1941.

In opening additional offices Dow Chemical Co. has appointed CLAYTON S. SHOEMAKER as Eastern sales manager and FREDERICK A. KOCH as assistant Eastern sales manager with headquarters in New York City while RALPH E. DORLAND continues as manager of the New York office. Shoemaker has been connected with Dow in various sales executive positions for a number of years and Koch has been assistant manager of the New York sales office for 15 years. ALEXANDER LEITH, JR., was named manager of the new office in Philadelphia and ALFRED A. LAWRENCE was named manager of the new Boston office.

United Air Lines' school and college service has been expanded with the appointment of four field representatives. KATHLEEN POWER, formerly dean of students at a Chicago college, is in charge of the Chicago district;

(*Continued on page* 381)

Donald M. Stuart

Kathleen Power

Frederick A. Koch

LIGHT WEIGHT
VIBRATION RESISTANT
hi-g*
ELECTRIC VALVES

CAN BE
MOUNTED ON ENGINES

Because they are vibration-resistant, General Controls *hi-g* Valves can be installed where they are best suited from a utility standpoint. General Controls electromagnetic valves operate in any position, regardless of vibration, acceleration or change of motion. Because they are vibration-resistant, they can be engine-mounted, simplifying plumbing, saving materials, saving space, saving weight, saving time, saving money.

Fast acting and light in weight (the Type AV-1 Valve illustrated above weighs but 8½ ounces!) these valves are designed for various automatic and remote control requirements. They are available in more than a score of types, handling aromatic or domestic gasolines or vapors, air, hydraulic oil, anti-icing fluids and lubricating oils, and pressures up to 3000 lbs. or more. Write or wire today for engineering data and Descriptive Bulletin.

*TRADE MARK—**hi-g** indicates positive ability to operate in any position, regardless of vibration, change of motion or acceleration.

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Wartime Manufacturers of Electro-Magnetic and Temperature Controls for Aircraft • Peacetime Producers of Automatic Pressure, Temperature, and Flow Controls

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but it took more than courage and skill to conquer the air

Wings . . . rudder . . . a power plant and man's courage launched the conquest of the air. Years of research and development have brought the flying machine to its present high state of perfection. But, it took more than a flying machine to conquer the air. Electronic Vacuum tubes and radio communications have, perhaps, contributed more than any other single thing to this great achievement.

Eimac tubes and Aviation have been close companions for years. The inherent stamina, high performance and dependability of the Eimac 250T (illustrated) helped make air travel safe by fulfilling its important role in the key sockets of aircraft ground stations and instrument landing devices throughout the nation. Today the marriage of Eimac tubes and the Aviation industry has been made complete by the cooperative advancement of both industries concentrating on winning this war.

Eimac and Aviation are together today to help win the war. They will stay together tomorrow to bring greater advancement in peace.

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Army-Navy "E" flag awarded for high achievement in the production of war material.

Follow the leaders to

Eimac
REG. U. S. PAT. OFF.
TUBES

George D. Shaeffer

C. Hart Miller

Joseph J. Acree

(*Continued from page* 379)
Leonard Eastley, Seattle, and Harry Sullivan, San Francisco.

ROBERT W. O'NEAL has joined the Follansbee Steel Corp., plants at Follansbee, W. Va., and Toronto, Ohio, as industrial engineer in charge of methods and standards. O'Neal came to Follansbee from the Carnegie-Illinois Steel Corp., where he held the position of assistant plant industrial engineer.

JOSEPH J. ACREE has been appointed personnel director of Chicago and Southern Air Lines. Before joining C & S Acree was with the SWPC and WPB where he was district manager for the Memphis and Jackson territories. Prior to that time he was associated with General Motors.

C. HART MILLER, vice-president of Republic Aviation Corp., has been named divisional manager of the company's Farmingdale, N. Y., plant. In assuming his new position, Miller has been succeeded in his post as director of the military contracts department by DON M. PARKER, assistant. Miller was an Army test pilot before joining Republic in 1935 and recently led a flight of 12 *Thunderbolts* in aerobatic maneuvers. Parker came to the company three years ago having previously been associated with Sikorsky and Wright Aeronautical.

Edwin W. Walker

Garrett C. Covington

Frank Shugert

GEORGE D. SHAEFFER has been named chief engineer of Gar Wood Industries' engineering department. Previous to his present assignment, Shaeffer was chief engineer of the road machinery division. A. C. EVANS has been promoted to chief engineer of the road machinery division. I. C. MOREAU has been assigned duties of chief engineer of the hoist and body division of Gar Wood while J. E. MONAHAN has been placed in charge of all hydraulic engineering.

GARRETT C. COVINGTON, for the last four years assistant chief engineer at McDonnell Aircraft Corp., has been promoted to chief engineer. He succeeds EDWIN W. WALKER, who has been named assistant to the president. Covington came to the company from the Glenn L. Martin Co., where he was assistant project engineer on the XPBM-1 flying boat. Walker has been in the aviation industry since 1925 and came to this company from Brewster. A new executive at McDonnell's is HARRY O. SMITH who recently assumed the post of director of industrial relations.

FRANK SHUGERT has been named director of industrial relations for the Elastic Stop Nut Corp. of America. He formerly held the same post for the Ranger Aircraft Engine Division of Fairchild Aircraft Co.

CLINTON M. HESTER has been appointed Washington counsel for Chicago and Southern Air Lines. Hester served as the first administrator of the CAA and as such supervised the construction of the Washington National Airport. F. W. WILDMAN, formerly of Dun & Bradstreet, Inc., has been named assistant to the president of Chicago and Southern.

NO NAZI can HEAR like you— WE made your EARS!

Zooming through the clouds, the crews of Army Bombers wear *super-sensitive* Earphones that give them hearing far keener than any foe—sharp, "clear-as-a-bell" reception of radio commands. They wear famous Radio Phones engineered by MURDOCK!

40% of Murdock employees are in the armed services. More will be going. MURDOCK women workers are carrying on—they're *proud* to be doing their job to help WIN THIS WAR!

For full information on MURDOCK Radio Phones, write Dept. 18 for Catalogue.

Wm. J. Murdock Co.
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Aircraft TOOLS' NEW STOP COUNTERSINK

1. Self Lubricating
2. Ratchet Stop
3. Positive Lock Ring
4. Faster, Smoother Cutting
5. Bell Shape Prevents Rocking

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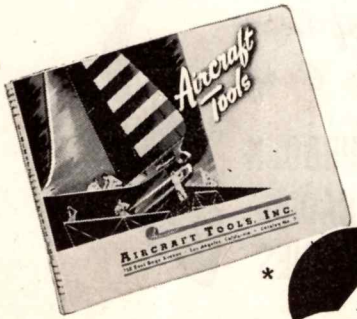
CAN'T ROCK

Accuracy with Simplicity

This newly designed Countersink can be used with the same accuracy by apprentice or skilled craftsman. Its simple, modern design permits the highest degree of accuracy with the minimum amount of effort. A simple ratchet stop permits easy hand adjustment by .002 of an inch. A positive lock ring maintains the setting, regardless of vibrations. Available in two sizes, 7/16" and 7/8" Cutters, using the same Pilots and Cutters as formerly used in *Aircraft* Tools, Inc., Countersinks.



Aircraft TOOLS, INC.*

LOS ANGELES 1, CALIFORNIA

*REG. U. S. PATENT OFFICE

FOREIGN REPRESENTATIVES: The A. R. Williams Machine Co., Ltd., Toronto, Hamilton and Vancouver, Canada ★ The Canadian Fairbanks-Morse Co., Montreal, Canada ★ Reginald M. Levy, Melbourne, Australia ★ Morris Black & Matheson, Ltd., Aukland, New Zealand Emilio Staub & Cia, Ltd., Sao Paulo and Rio de Janeiro, Brazil, S. A. ★ W. A. Ramsey, Ltd., Honolulu, Hawaii

K. R. Beardslee

Hiram S. Hall

Everard M. Lester

EDITH JUELL, with the public relations staff of Transcontinental & Western Air for the last two years, has been named co-operative advertising manager for the airline. She will be in charge of all cooperative advertising projects for TWA including promotion and display tie-ups.

G. E. THOMAS is the manager of the new office of Aircredit, Inc., Forth Worth, Tex., which was recently opened in Birmingham, Ala.

K. R. BEARDSLEE, for the past seven years general sales manager for Carboloy Co., Detroit, has been made vice-president in charge of sales. With the organization for 13 years, Beardslee is a member of both the Wire Assn., and the American Society of Tool Engineers.

HIRAM S. HALL has been named industrial relations director at Ranger Aircraft Engines Division of the Fairchild Engine and Airplane Corp. The new director was formerly in charge of the Queens Industrial Commission.

The services of R. RANDALL IRWIN, for ten years industrial relations director of Lockheed and Vega, has been loaned to the government as executive assistant to the management members of the War Manpower Commission's policy committee. He has served as a member of this committee since its inception, dividing his time between Washington and Burbank. At the same time Irwin has been named to a new position in the companies, that of assistant to the administrative vice-president. WILLIAM M. AULEPP was appointed industrial relations director for Lockheed and Vega, with R. B. ROBERTSON continuing as assistant director.

R. E. BROWN, works manager of the Consolidated Vultee Miami division, has been named to the same post at the new Allentown, Pa., division. Brown has been replaced in Florida by E. N. LAURANCE, factory superintendent, who is now acting works manager. Brown entered aviation 25 years ago with Curtiss and has served with Aero Marine at Keyport, N. J., Wright, Bellanca and Sikorsky. Laurance served his apprenticeship with the Gwynne Aero Co., in London and later was associated with Chance Vought and Spartan.

Three executive promotions at the Ranger Engines Division of Fairchild Engine and Airplane Corp., include EVERARD M. LESTER, assistant chief engineer, who is now assistant general manager; C. P. SANDERS, formerly development engineer, who has succeeded Lester, and PAUL BATTILANA, who was elevated from service manager to assistant manager of contracts.

WILLIAM B. GRIESE, formerly plant manager of the Liquid Cooled Engine Division of the Aviation Corporation, has been transferred to plant manager of the Spencer Heater Division at Williamsport, Pa. C. N. TULL, formerly plant manager, will continue to assist Griese in industrial relations matters.

E. N. Laurance

William B. Griese

R. Randall Irwin

"BOMBS AWAY!"

MASSIVE Bomb Bay doors must swing open *instantly*... if a Flying Fortress is to deliver its deadly cargo "on the nose."

That's why electric control motors . . . that open and close Bomb Bays, raise and lower landing gear and wing flaps, and operate gun turrets on America's biggest bombers . . . are built to the highest standards of Eureka* craftsmanship and precision.

Little larger than the motor in a vacuum cleaner, these Eureka-made controls are precision-built to meet the most exacting demands of combat flying conditions.

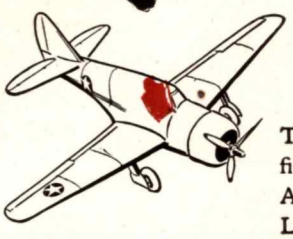
*Designed by Eclipse Aviation Division, Bendix Aviation Corporation, and built by Eureka Vacuum Cleaner Company, Detroit.

Starter motors for fighting planes . . . precision control motors . . . pyrotechnic signal devices . . . gas masks . . . are other Eureka wartime products.

EUREKA

PRECISION...IN WAR AS IN PEACE

Armor Plate



ARMORED PROTECTION AGAINST THE ENEMY

The pilots and gunners of America's hard-hitting fighting aircraft rely on the protection of Breeze Aircraft Armor Plate to help "bring 'em back alive". Light in weight, this Armor Plate is engineered in a wide range of special shapes and sizes to meet designers' requirements.

Produced by the Breeze Electric Heat-Treating Process, the fastest known for this purpose, Breeze Armor is standard on American fighters and bombers. Today, Aircraft Armor Plate supplements the many other well-known items of Breeze equipment which are being produced in ever-increasing quantities for the fighting forces of the United Nations.

BREEZE CORPORATIONS, INC., NEWARK, N. J.

Breeze

BREEZE MARK

Kurt W. Renson

Harold E. Reed

Frank A. Rudolph

HAROLD E. REED has been named vice-president in charge of production of Engineering Laboratories, Inc., consulting engineers and manufacturers of specialized precision aviation equipment. Reed entered the aviation industry in 1928 as head of the planning and production department of Waco Aircraft. Since that time he has held positions with Curtiss-Wright, Beech Aircraft and recently with Cessna.

FRANK A. RUDOLPH has been appointed Eastern Regional Manager of Aircraft Accessories Corp., with offices in New York City. Prior to his connection with Aircraft Accessories he was affiliated with the General Electric Co., in the radio, television and electronic division.

KURT W. RENSON, industrial chemist, has joined the Los Angeles laboratory staff of Turco Products, Inc. A graduate of the College of Industrial Chemistry in Vienna, Renson is a member of the American Chemical Society.

THE AIR SERVICES

The Women Are the Wasps Now

Latest cognomen for the female accessories to the armed services is WASP, chosen for the women pilots of the Army Air Forces by Gen. Henry H. Arnold, commanding general of the AAF.

The official title of the women flyers is Women's Air Force Service Pilots and this includes the pilots of the women's auxiliary ferrying squadron formerly known as WAFS, those of the women's auxiliary training detachment and those on assignment to other flying services within the Army Air Forces.

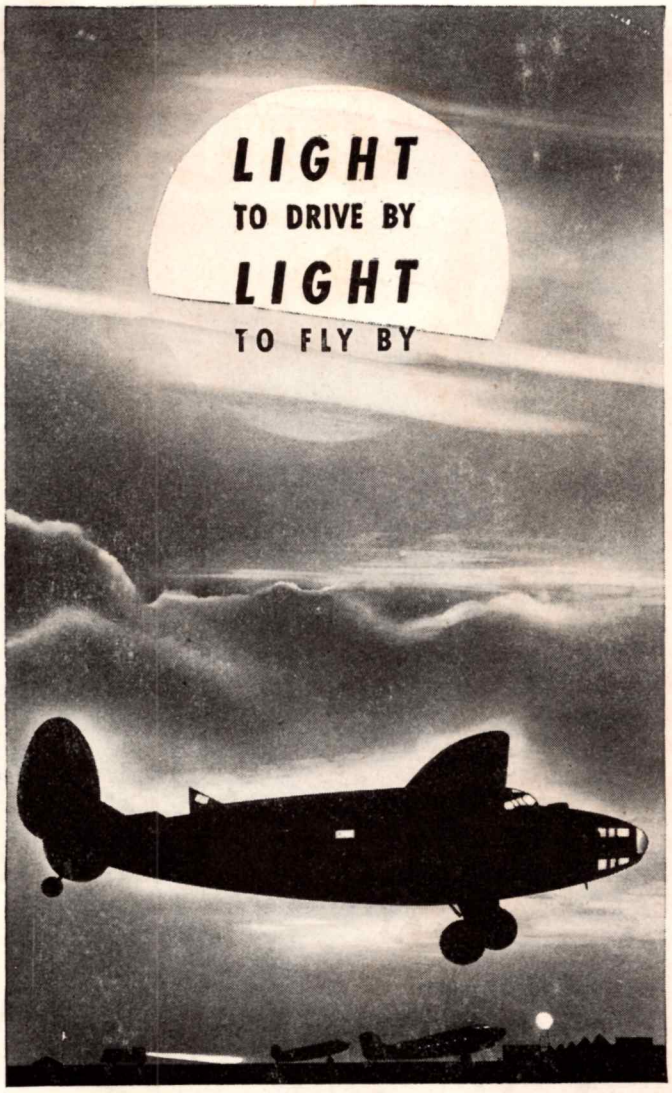
Although the women wear a distinctive uniform they serve the AAF in a civilian status and are not members of the forces.

Mrs. Nancy Harkness Love, senior Squadron Leader of the original WAFS is now the executive for WASP ferrying operations, Air Transport Command, Cincinnati, Ohio, Miss Jacqueline Cochran as Director of Women Pilots, in Headquarters Army

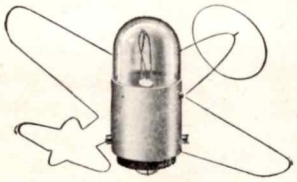
(*Continued on page* 387)

Acme

The largest aircraft yet designed, Henry Kaiser's cargo seaplane, is more than twice the size of a "Flying Fortress." One of three being built, it is to be 218 ft long, have a wingspread of 320 ft and will weigh 200 tons. The fuel capacity will be 8000 gal and the cruising speed 174 mph



Whether in a car, truck, tank or plane, TUNG-SOL Lamps give the same dependable performance. Since the days when electricity replaced oil and gas for motor vehicles illumination, TUNG-SOL LAMPS have had acceptance for both initial equipment and renewal. Today you find TUNG-SOL Lamps in the most exacting services throughout the world. Specify TUNG-SOL when ordering lamps



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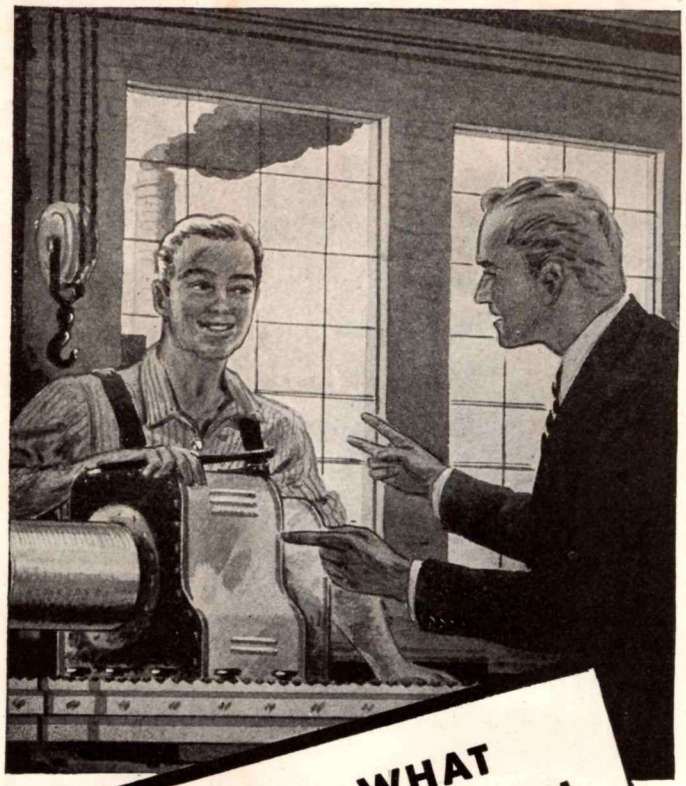
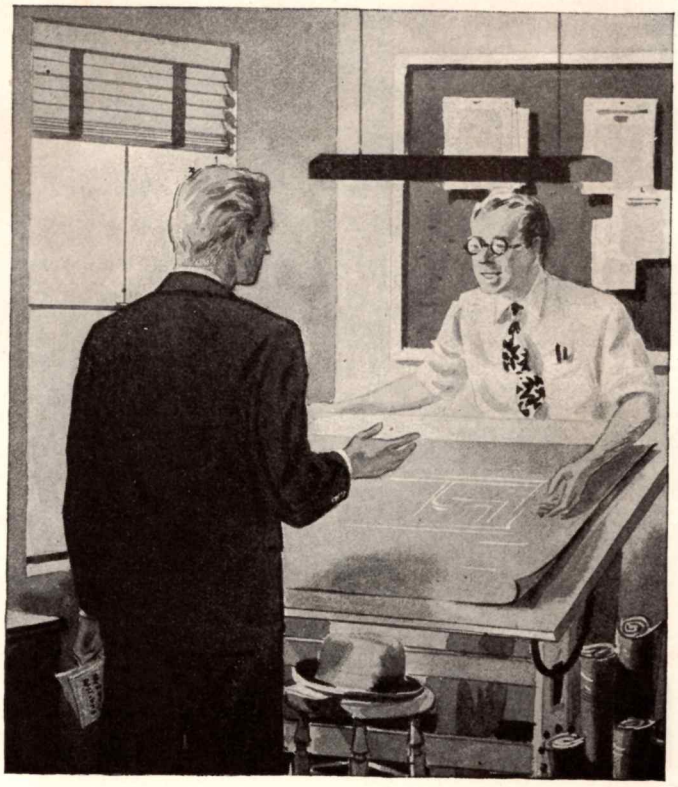
AIRCRAFT LAMPS

TUNG-SOL LAMP WORKS INC., NEWARK, N. J., Sales Offices: ATLANTA, CHICAGO, DALLAS, DENVER, DETROIT, LOS ANGELES, NEW YORK, PHILADELPHIA.
ALSO MANUFACTURERS OF RADIO TUBES AND THERMAL SWITCHES.

★ HELPING AMERICA PRODUCE MORE! ★

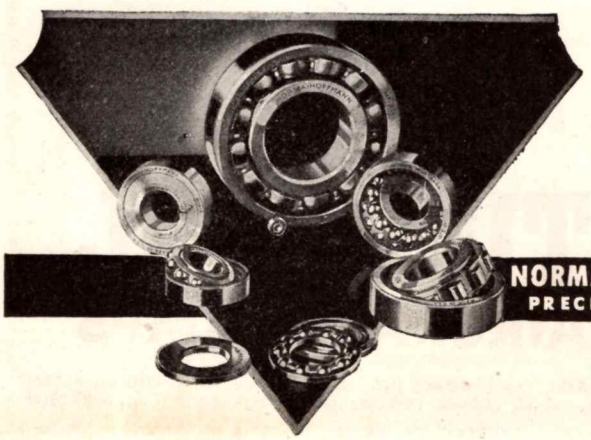




THAT'S WHAT NORMA-HOFFMANN FIELD ENGINEERS ARE DOING, TODAY

★ They're out on America's "production fronts," giving freely of their highly specialized experience, assisting manufacturers of armament, equipment, munitions and supplies in keeping production lines moving. They're aiding MACHINE BUILDERS to apply anti-friction bearings more economically and efficiently. They're helping MACHINE USERS to get the most from the bearings they have—to lengthen their life—to reduce shut-down hazards. At our factory, The Engineering and Research Departments are equally busy, solving problems in bearing application, operation and maintenance submitted by buyers of bearings in every field. And all this service is being rendered without cost, THAT AMERICA MAY PRODUCE MORE.

Write for the Catalog.
Let our engineers work with YOU.



NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U.S.A.
PRECISION BALL AND ROLLER BEARINGS — FOUNDED 1911

BUY MORE UNITED STATES WAR BONDS, TODAY

(*Continued from page* 385)
Air Forces, Washington, D. C., directs both training and operations of the WASPS, and in coordination with the Assistant Chiefs of Air Staff and the Air Surgeon, determines measures for effective utilization of WASPS, their requirements and standards.

Navy Air Strength Will Reach 27,500

As the U. S. Navy air arm reached its 30th anniversary last month, Vice-Admiral John S. McCain emphasized the progress made in the 30-year period, stating that by the end of this year the Navy would have 27,500 planes. This compares with naval aviation at the beginning of World War I, when there were 38 officers, 163 enlisted men and 54 airplanes.

Admiral McCain was recently appointed to the new position of Deputy Chief of Naval Operations and handles the vital functions of Navy aviation including combat and training. The new position which is in the offices of Admiral Ernest J. King, Chief of Naval Operations, will bring about changes to increase the responsibility and autonomy of the Navy's aeronautical organization in procuring the finest aircraft types and in perfecting training and supply systems.

Besides the increase in combat planes Admiral McCain commented upon other developments such as the 30,000-a-year pilot training program; a 100,000-a-year mechanics training program; air stations, and facilities throughout the world; material development, flight-test and aircraft delivery terminals; a large number of "baby flat-tops" for convoy and ferrying as well as combat duty a lighter-than-air-fleet of 200 aircraft, and over 100 areas served by the naval air transport over routes covering 60,000 miles.

Admiral McCain said that our naval airplane strength had grown six times its original size in 1941 over 1940, had doubled again in 1942 and he expected 1943 to triple that of the previous year.

AAF Rehabilitation Program Gets Results

The two-fold purpose of the Army Air Force's newest rehabilitation program aids the convalescents for their re-entry of service and prepares the discharged men for quick adaptation to civil life. Under the direction of Lieut. Col. Howard A. Rush, the Air Corps Convalescents Training Program keeps the patients busy in all their free hours.

The men who will return to service are given the opportunity for additional training by the study of foreign languages, geopolitics, tropical diseases and other subjects that will aid them later in the armed forces. The classes are specially designed to fit the patients' needs and interests even though they may be bedridden. Mathematics and physics are among the classes in session while one former patient reported he had prepared for mechanical schools while hospitalized. Special receiving and sending sets are provided for radio operators so that they will not lose code speed as a result of even a week's inactivity.

Doctor-patient talks have aided the soldiers cope with future problems by giving preventative medicine. Physical training classes are being conducted and a number of victory gardens have been raised.

Another feature of the program is the use of patient-teachers. Highly trained men with wide experience conduct informal classes and it was estimated that 75% of the instructors are patients.

Colonel Rush said that the use of the convalescent program has cut down readmission 25% in some hospitals.

AIR TRANSPORTATION

Netherlands Airline Inaugurates Miami Run

Semi-weekly direct air service between the Netherlands West Indies and Miami has been inaugurated by Royal Netherlands Airlines (KLM). This is a predecessor to lines which are expected to be opened between the Dutch Caribbean islands and countries of South and Central America, according to M. E. A. L. de Jong, acting manager director of the company.

The first plane on the new link left Willemstad, Curacao, for Miami with Dutch pilots flying American-built Lockheed planes. Two routes are included in the service, alternating from Curacao and Aruba, with stops at Kingston, Jamaica; Port au Prince, Haiti, and Camaguey, Cuba. Previously air service from these islands had been by connecting planes. Flying time, which is one day by either route, has been reduced one-half.

Countries already served by

MILFORD
profile saw
The blade for all contour and profile band saw machines

NOW BETTER THAN EVER!

You can now bank on more production than ever from your contour and band saw machines . . . when you use improved MILFORD PROFILE SAW blade to do the cutting.

A new automatically controlled method of heat treatment guarantees the uniform depth of hardness of every foot of PROFILE SAW. This accurate control of the depth of hardness of each tooth is tested by "etching" sample pieces of each saw. It's an exclusive new process . . . another contribution of specialists with over sixty-five years of experience in metal band saw manufacturing.

ORDER FROM YOUR MILL SUPPLY DISTRIBUTOR

Have you adapted your band saw machines to Profile Sawing? If not, write us for directions and a free sample. Include specifications of your machines and the cutting jobs you would like to do on them.

THE HENRY G. THOMPSON & SON COMPANY
NEW HAVEN, CONNECTICUT
Also makers of MILFORD REZISTOR HACKSAW BLADES

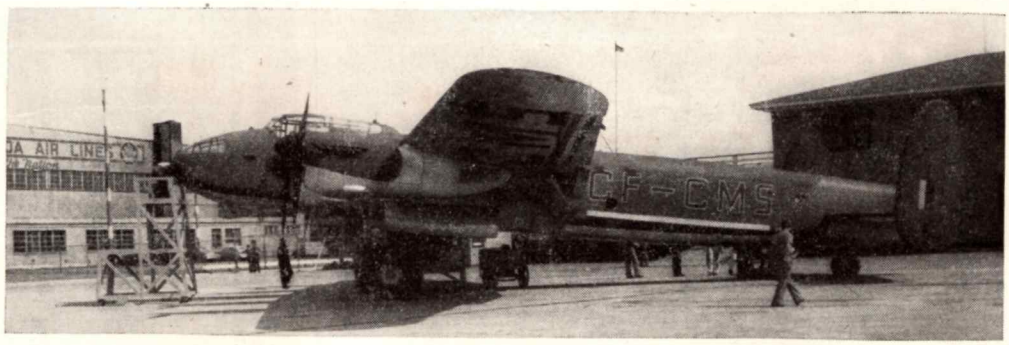
the company are Venezuela, Colombia, Trinidad and the Dominican Republic. Since KLM began operations in the Western Hemisphere in 1935, it has multiplied its annual passenger traffic approximately 12 times and its annual mileage nearly 20 times.

Delta Would Serve 24 More Cities

Delta Air Lines has filed application for authority to extend its present network to serve 24 additional cities, including one additional route and seven major extensions to present routes. The company asks lines which would touch fourteen states, eight of which are not now on Delta's itinerary.

Serving the South since 1925, Delta points out that this section is becoming increasingly important in the industrial pattern of the nation and the airline advocates that direct outlets into key cities of the East, Middle West and Florida be provided. The longest extensions sought would lead into New York, Miami and Kansas City.

The new applications would lengthen Delta's system about 3500 miles to municipalities in the District of Columbia, Florida, North Carolina, Virginia, West Virginia, Maryland, Pennsylvania, New York and Missouri. The applications enlarged those filed in 1941 but on which action has been held up by the war.



A Trans-Canada Air Lines crew established a non-stop record of 12 hours 26 minutes on a Montreal to Britain hop with this Lancaster transport

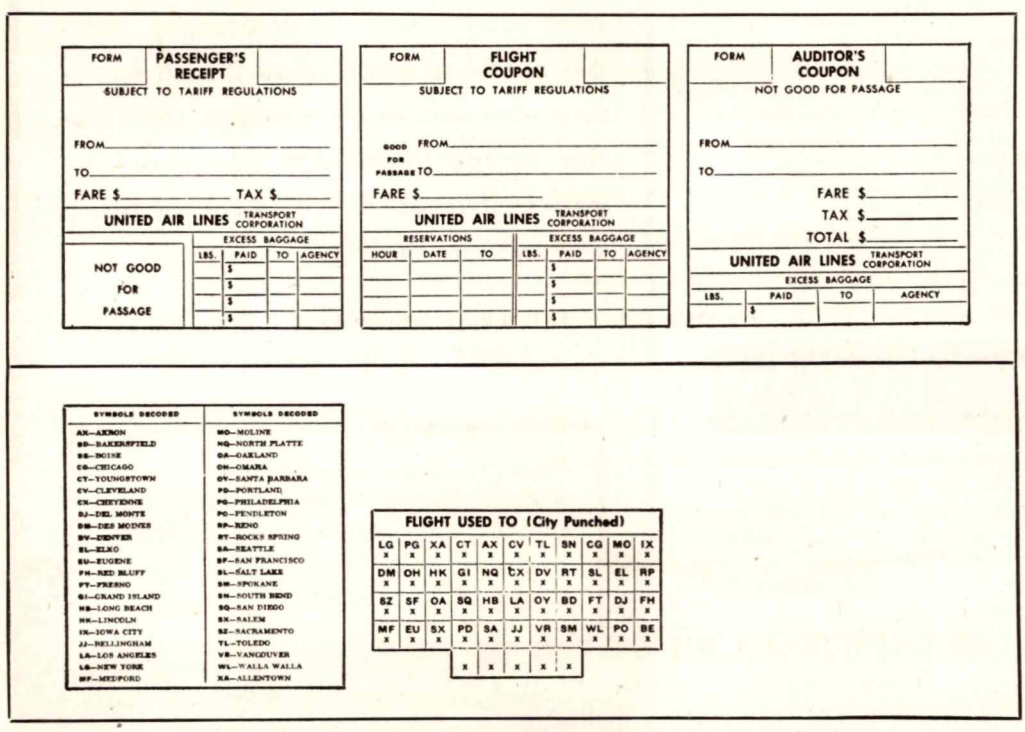
United Streamlines Passenger Tickets

United Air Lines has developed a new passenger ticket which slashes man-hours, printing and paper stock. It is now in use on the company's coast-to-coast and Pacific coast systems. Designed by George Fleming, United auditor of revenues, after years of study of railroad and airline ticketing procedures, the system is being made available to other airlines.

The new tickets range in size from 5⅜ inches to 8½ inches and can be utilized for either short or long distance trips. The old style forms unfolded from 6 to 25½ inches, depending upon the length of the trip, and required 6 minutes to fill out. The new ticket can be made out in as little as 20 seconds.

Instead of requiring a separate flight coupon for each stop-over or connecting point en route, the passenger now only needs one flight coupon, regardless of distance or stop-overs so long as he continues in one general direction. If the trip direction is to be changed a ticket with two flight coupons, one for each direction of travel, is issued. The new coupons are arranged in horizontal rather than scroll order and are used from right to left instead of from bottom to top.

Under the old system when a passenger deplaned before his scheduled destination, a passenger agent had to re-issue a ticket and provide flight coupons necessary for each stop. Using the new tickets a passenger who wishes to stop over or transfer to some other modes of travel merely has the agent punch the flight coupon at the point of deplaning. The agent then gives the passenger a refund check, provides another means of transportation or arranges for another seat on a later flight.



United Air Lines saves time and paper with this new streamlined ticket. Back and front views of the open-form one-way ticket are shown. This replaces old forms which ranged up to 25½ inches long, and does away with former complicated methods for handling stop-overs

Set Transport Record to Europe

A new record of 12 hours 26 minutes was chalked up in a non-stop flight from Montreal to Britain by a Trans-Canada Air Lines crew flying a large transport plane in the Canadian Government's new wartime transatlantic mail service to and from the Dominion's overseas forces. This bested the previous record by 25 minutes.

The airplane, which was piloted by Capt. Ronald F. George, operations manager of TCA, carried 2600 pounds of mail, three official passengers, besides the regular and return trip crew members.

The record breaking crew included Captain George; Squadron Leader J. R. Gilmore, navigator; Capt. A. Rankin, co-pilot, and G. Nettleton, radio operator.

The second TCA crew and passengers were: D. S. Florence, D. F. C.; Capt. M. B. Barclay; A. J. Blackwood; Capt. R. M. Smith; C. S. Hewett; W. Houston, superintendent of a De Havilland aircraft plant; J. R. K. Main, inspector of airways, Department of Transport, and C. S. Ritchie, executive secretary, Department of External Affairs, High Commissioner's Office, London.

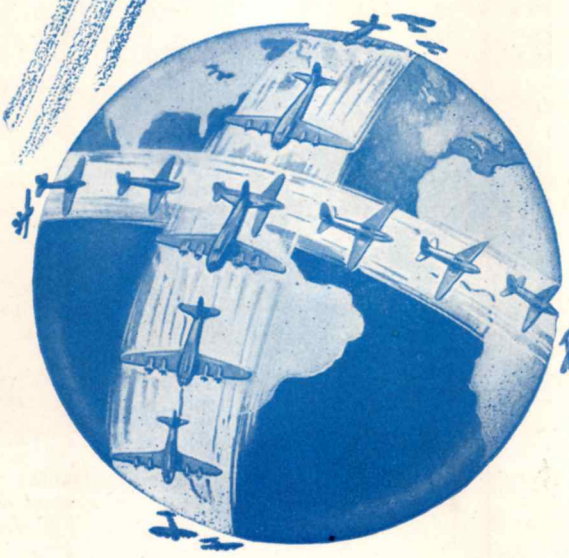
PCA Asks Authority for More Short Hauls

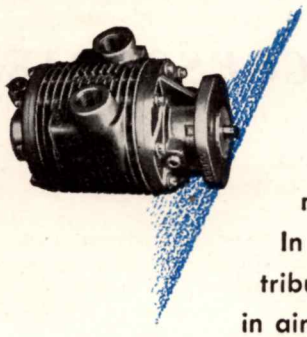
Pennsylvania-Central Airlines, advocator of short haul air transportation, has asked authority from the CAB for an extension of operations into 22 additional cities in four states in the Eastern and New England sections.

The new routes would connect PCA's main terminal in Washington, D. C., with New York and Boston and from these points branch out to a group of municipalities. Flight schedules in the new application would serve Wilmington, Del.,

(*Continued on page* 393)

POLICE POWER FOR *Peace...*





Down the sea of centuries man has sailed the ship of his dreams in pursuit of the pathway to peace. Perhaps his dreams may soon bear fruit. For the hope of a police power for world peace may yet become a reality at the close of the present conflict. In the struggle for the attainment of that aim, America pays tribute to the tireless efforts of every man and woman engaged in aircraft. For it is THEY who produce the power so essential to police the future peace.

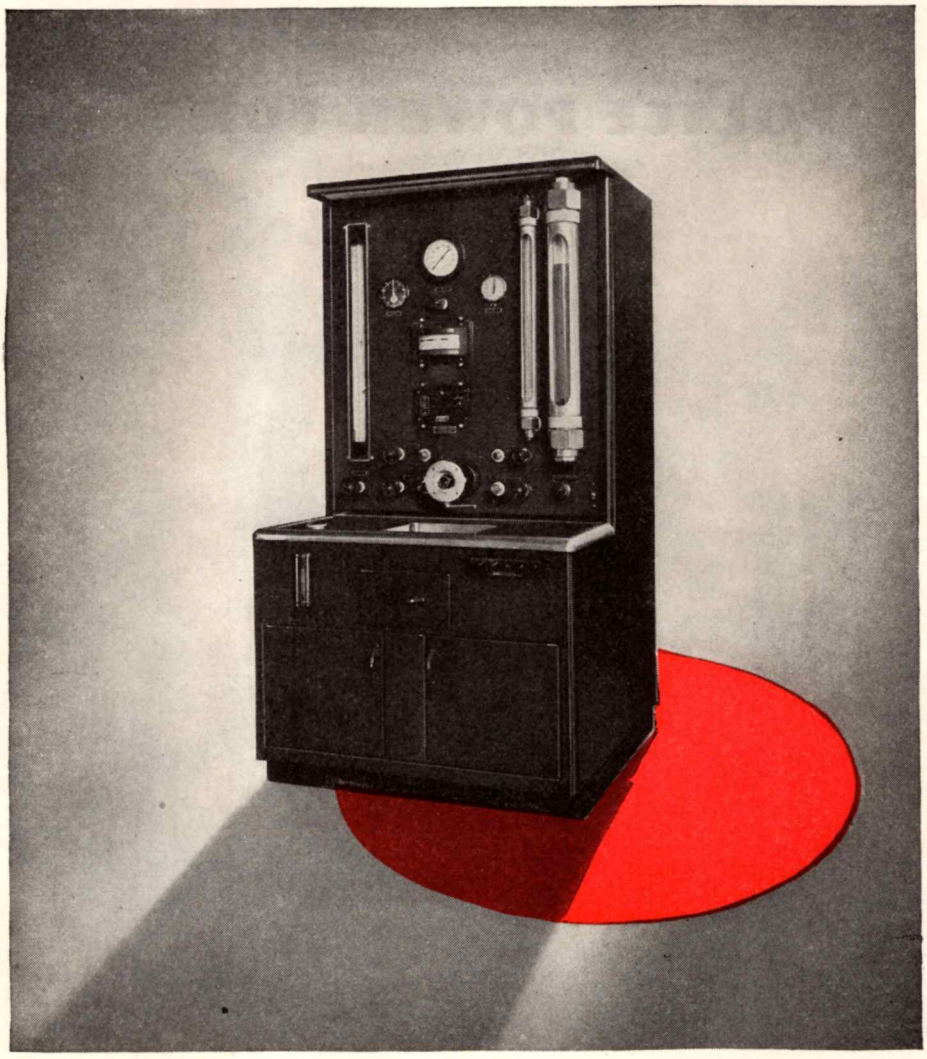
ROMEC PUMP COMPANY • ELYRIA, OHIO, U. S. A.

Manufacturers of Aircraft Pumps and Accessories

FIRST IN DEPENDABILITY

Romec

BUY WAR BONDS



TEST EQUIPMENT FOR AIRCRAFT ACCESSORIES

Pictured above is our Type TE-872 test stand made to adjust, calibrate and test hydraulic pumps. Compact, simple to operate, this test stand is only one of many types designed, engineered and manufactured by Air Associates, Inc. . . . Similar units are available for checking fuel and vacuum pumps, propeller governors, complete hydraulic systems, including actuating cylinders, hand pumps, relief and check valves, and other engine driven aircraft accessories and mechanisms . . . In addition, *we offer a complete engineering service to produce standard or special test units to meet any need of aircraft manufacturers, and military and commercial operators.* Complete data for several types of test stands in current production furnished on request.

AIR ASSOCIATES, INC.

TETERBORO, N.J. . . . *BRANCHES:* CHICAGO, DALLAS, LOS ANGELES . . . ENGINEERS & MANUFACTURERS OF AIRCRAFT SPECIALTIES . . . SUPPLIERS OF ALL TYPES OF MATERIALS TO THE INDUSTRY SINCE 1927

These workmen are doing their job in clean, healthful surroundings using Paasche Airpainting Equipment in a plant "somewhere in Kentucky" building the famous Curtiss Skymaster.

Paasche

WATER WASH BOOTHS

Eliminate Fire Hazards—Assure Clean Exhaust
Conserve Paint—Promote Healthful Working Conditions

★ Add production hours to your day. Eliminate the time-wasting, hazardous job of spray booth cleaning by installing Paasche Self-cleaning Water Wash Booths.

★ Paasche Water Wash Booths reduce fire hazards to a minimum and are endorsed by safety engineers and industrial commissions. For these reasons the Paasche booth is selected where safety is a prime requisite.

★ Based on the principle that *paint can't stick to water,* they employ a constant curtain of water and the action of powerful sprays in the water wash chamber to wash down the overspray that otherwise accumulates on walls of booth, air distributing plates, fans and exhaust ducts. When air is exhausted, it is clean and free of paint particles. In many cases the precipitated solids can be reclaimed, making a substantial saving!

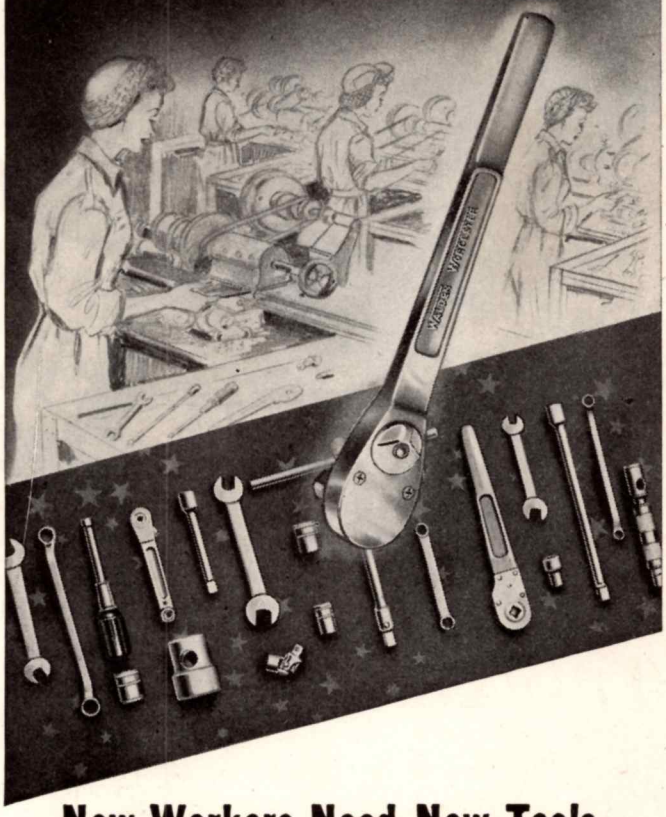
★ A sound, economic investment, Paasche Booths usually pay for themselves quickly in time and material saved. Booths are engineered to your individual needs. Write today for full information on Paasche Water Wash Booths and other Manual or Automatic Airpainting Equipment. Paasche Airbrush Co., 1937 Diversey Parkway, Chicago, Illinois.

Paint Can't Stick to Water.

Paasche AIRPAINTING EQUIPMENT

Manual, automatic and special airpainting equipment, airfinishing booths, pressure regulators, airconditioners for compressed air lines, air dusters and stripers.

Modern Tools for the NEW WORKERS



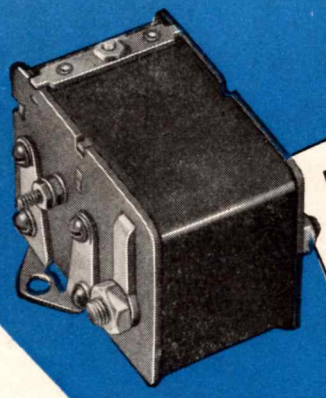
New Workers Need New Tools
Modern in design — strong-light — durable. Walden-Worcester in its long years of experience has always been a leader in making hard jobs easier by engineering its tools on the drafting board and testing them on the workbench. Don't buy heavy, clumsy tools when Walden - Worcester Tools are available.

STEVENS WALDEN ORCESTER WRENCHES TOOLS & BOXES

STEVENS WALDEN, INC.
458 SHREWSBURY STREET
WORCESTER, MASSACHUSETTS, U. S. A.

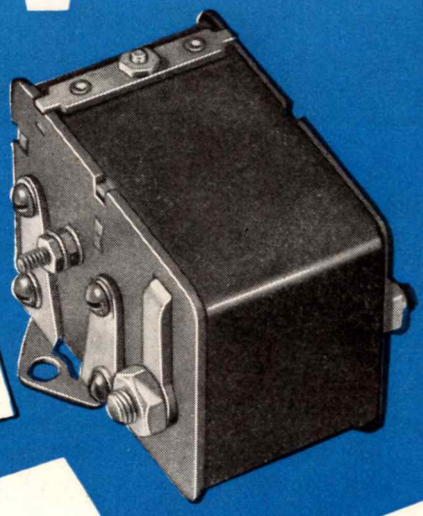
NEW

50- AND 100-AMP AIRCRAFT CONTACTORS



50 AMP
4.3 OZ (0.27 lb)

100 AMP
10.5 OZ (0.66 lb)



LIGHTER THAN ANY OTHERS OF EQUAL RATING

Balanced armature construction increases their ability to withstand vibration, while permitting a reduction in weight.

TWO FORMS AVAILABLE—one which conforms to specifications of the U.S. Army Air Forces; one with simplified mounting and terminal arrangement (as illustrated) which saves additional weight and space

TEMPERATURE RANGE—95 C to −40 C

ALTITUDE RANGE—0 to 40,000 feet

LINEAR ACCELERATION—Up to 10 G applied in any direction

VIBRATION—Meets U.S. Government vibration specifications

CORROSION-RESISTANT—They meet 200-hour salt-spray test as stipulated by various Government agencies.

DELIVERIES BEING SCHEDULED NOW

We are *now* accepting orders for quantity production, and can make deliveries to meet your production schedules. See your nearest G-E representative immediately for samples.

For our new catalog (GEA-3865) on G-E control devices for aircraft electric systems, including contactors, limit switches, relays, and pressure switches, write to General Electric Company, Schenectady, N. Y.

AIRCRAFT CONTROL

GENERAL ELECTRIC

676-87-8940

(*Continued from page* 388)
Philadelphia, Trenton and Newark to New York, and from New York to Boston through Bridgeport, New Haven, New London, New Bedford, Fall River, Providence, Attleboro, Taunton, and Brocton in New England. Another route would connect New York with Boston via New Britain, Waterbury, Meriden, Bristol, Hartford, Springfield and Worcester.

Dedicates Base

American Export Airlines recently was host at formal dedication ceremonies of its new marine base at LaGuardia Field. Principal speaker for the occasion was Secretary of the Navy Knox and guests included Mayor LaGuardia of New York, Capt. J. V. Whitney, Naval Air Transport Service; Thomas Burke, State Dept.; Eugene Casey, executive assistant to President Roosevelt, and Oswald Ryan of the CAB.

Ferry Pilots Organize Trans-Oceanic Airline

A group of Air Force Ferry Command pilots has filed a registration statement with the Securities and Exchange Commission covering the original issue of capital stock for the organization of a world-wide airline, to be known as Trans-Ocean Air Lines, Inc.

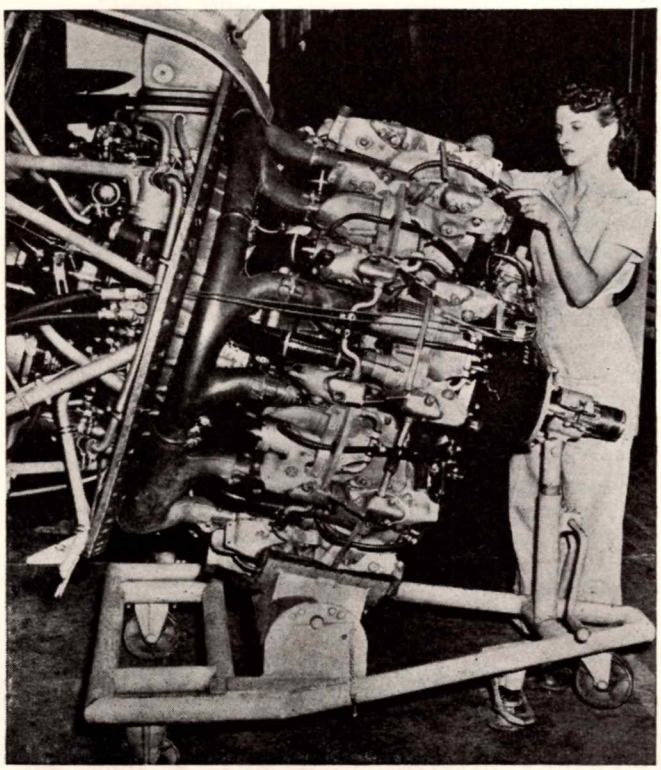
Its founder proposes to be prepared to begin operations immediately after the war with regular service to any part of the world. The organization, headed by Capt. Thomas G. Smith of Atlanta, also includes 11 other ferry pilots who propose to provide complete flight crews, comprising pilots, navigators, engineers and radio operators.

The registration statement covers 300,000 shares of no-par value Class A voting stock to be offered to the personnel of the Ferry Command at no more than 1000 shares to a captain, pilot or co-pilot, and no more than 300 shares to flight crew members and to the officials and department heads of the corporation. Value of the stock will be $1 in the United States and $1.10 in Canada.

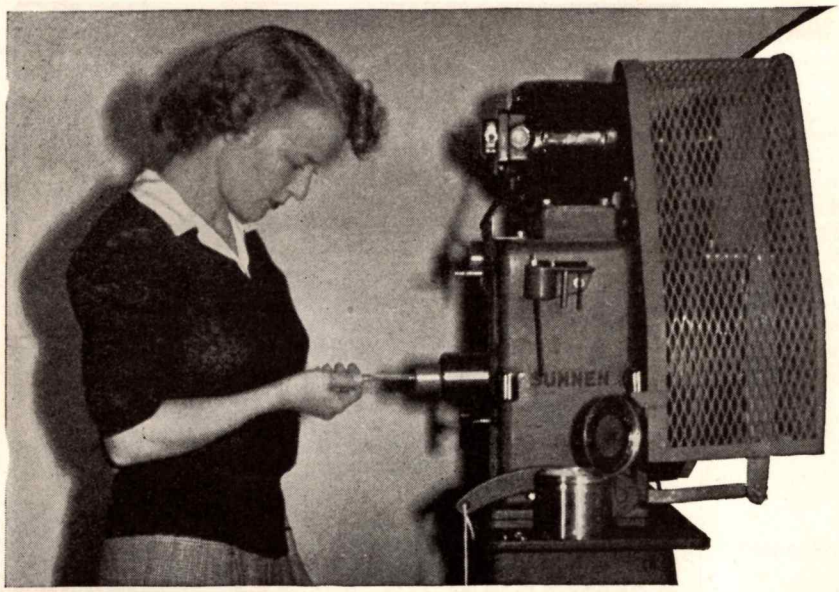
It was said that approximately 250,000 of the presently authorized capital of 300,000 shares of class A voting stock will be required to provide the minimum number of complete flight crews and operating personnel of the corporation which is considered advisable at this time, with the remaining 50,000 authorized but unissued shares to be held in the treasury of the company.

Braniff Texas Service

Braniff Airways began service recently between the Northwest and Central and south Texas. Braniff airplanes are carrying mail, express and passengers on Dallas-Denver and Amarillo-Denver routes with transit time of six hours.



New engine stand devised by Pan Am engineers makes it possible to reach with ease all parts of an engine during overhaul

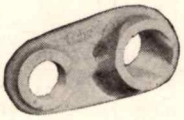


Thanks to the

SUNNEN PRECISION HONING MACHINE

GIRLS IN 'TEENS

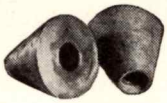
are handling jobs in "tenths"!



Aluminum Aircraft Link "produces high finish without bell-mouthing."

Inner Bearing Ring "Accurately removes last 'tenth' of stock."

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.



Cones for Wheel Balancing Machine "Accurately align hones two interrupted surfaces."

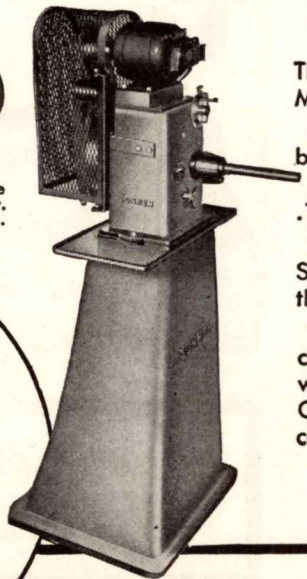
Aviation Hydraulic Cylinder made of Aluminum-Alloy. Improves the quality of the bearing surface. An extremely smooth surface-finish is secured.

Aircraft Valve Tappet Roller. 4-Micro finish.

and what's more remarkable, they can be trained for such accurate work in a few hours.

That's only one reason manufacturers of combat equipment and munitions have adopted the SUNNEN Precision Honing Machine.

The guaranteed accuracy (.0001″) and super-smooth finish (2 to 3 micro inches) assure fewer rejects and interchangeability of parts. These advantages not only speed production, but prevent waste of vital war materials.



Low in Cost—Economical to Operate

The basic price of the Sunnen Precision Honing Machine is only $195! And it's economical to operate.

No jigs or fixtures—work is held in hands. Relieves big internal grinders for other jobs.

Wide range—handles any internal diameter from .185″ to 2.625″.

Protect your previous operations by using the Sunnen method for that most important operation—the last one.

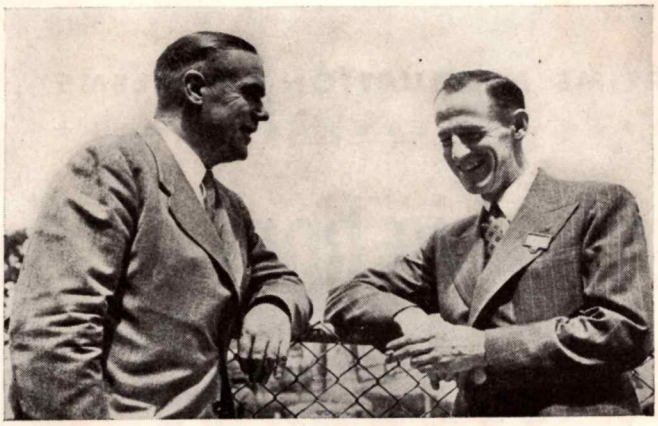
It's easy to find out just what Sunnen equipment can do for you on your job—one of our engineers will be glad to call and help you solve your problems. Or—if you prefer—write for free bulletin giving complete information.

The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen equipment is playing in the war effort.

SUNNEN

SUNNEN PRODUCTS COMPANY, 7945 Manchester Ave., St. Louis, Mo.

Canadian Factory: Chatham, Ontario



Right: Reginald M. Ansett, president of Ansett Airways, Australian airline which operates Wright "Cyclone"-powered Lockheed "Electras," discusses wartime air transport problems with Kenneth J. Boedecker, sales engineer of Wright Aeronautical. Mr. Ansett is now on a visit to American war plants

Northeast Introduces Simple Timetables

Airline passengers won't get lost in a maze of figures when using the new timetable introduced by Northeast Airlines. NEA's new streamlined schedule has arrival and departure time reading from left to right so that the customer can quickly and easily find the desired information by simple, ordinary reading.

According to the airline, this horizontal form was consumer-tested several months in advance of its introduction, and those interviewed expressed an eight-to-one preference for it. The new arrangement will eliminate eye fatigue as there are fewer eye movements involved in reading from left to right, which is the habitual eye function. This simplified identification of flight times causes no eye strain or reading complications and will react more favorably on the entire nervous system of the passenger, it is said.

American Makes New Applications

A new route application by American Airlines stems from the need for direct air service between Ottawa, Canada and Washington, D. C. The airline asks a route to connect with its main line at Syracuse, N. Y., to the Canadian capital.

At present, travel between Washington and Ottawa involves a choice of two routes, in which the shorter flight distance is accomplished by the use of three different airlines; the longer requires two airlines. The proposed new route between Syracuse and Ottawa would permit American to fly direct from Ottawa to Washington via Syracuse and New York. In addition to this application, American asks for a route from Syracuse to Montreal via Watertown and Massena, N. Y., a route which is not covered at present.

New Routes

Two round trips daily have put Washington on TWA's new direct coast-to-coast route. These flights tap the airline's main transcontinental airway at Dayton via Columbus and Wheeling, W. Va. Two other flights provide service to Chicago and main line points, through connections at Dayton. Departures from Washington are at 9:15 A. M. and 5:15 P. M.

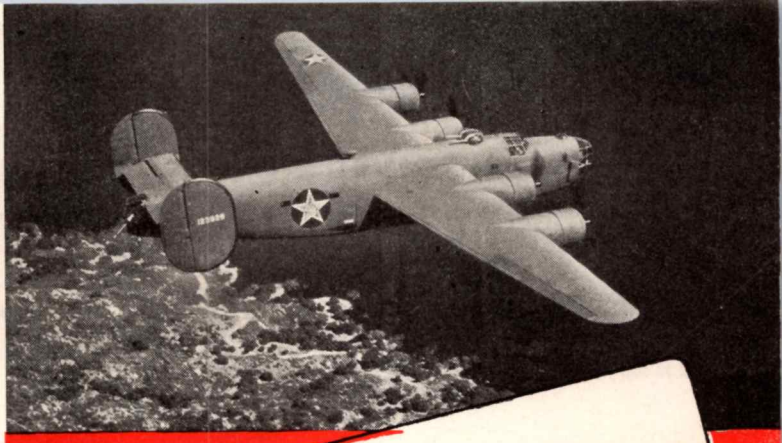
UAL has begun operation of a new direct route from Washington to the Pacific coast. Nonstop flights between the nation's capital and Toledo now are linked with the company's transcontinental route. United's two daily round-trip flights place the two coasts overnight apart, with flights leaving Washington at 5 and 7 P. M. to arrive on the Pacific coast the next morning. Eastbound planes leave California at the dinner hour and reach Washington at 2:22 and 4:37 P. M.

Latin American Air Service Stepped Up

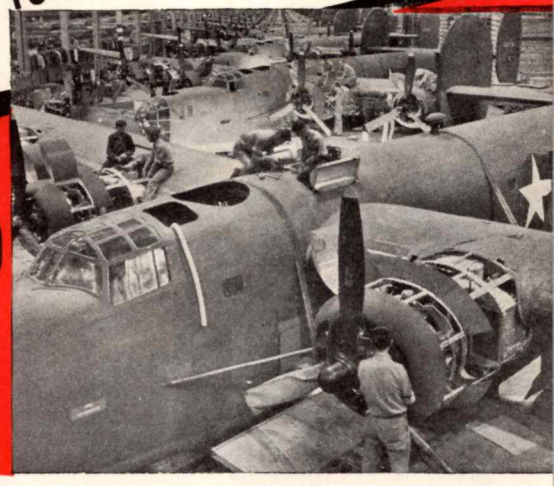
Lighting improvements on two of Pan American World Airways' aerial trunk lines will cut down air travel time from two days to one. Work has been under way on night lighting facilities on the service from Brownsville, Tex., to Guatemala City via Mexico City, and the Miami to Belem leg of the route to Buenos Aires.

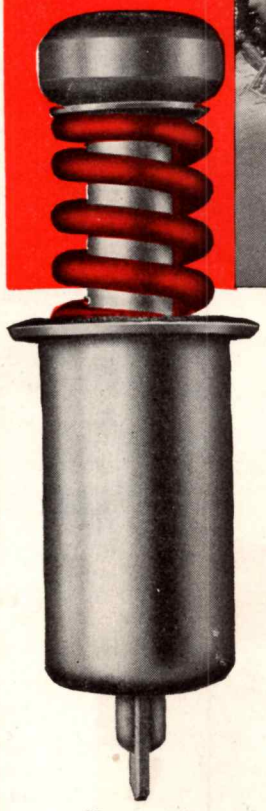
Installation of the beacons will reduce from two days to one the trip from Brownsville to Balboa. On the Miami-Belem route the round-trip flights from Miami to San Juan, P. R., will be

(*Continued on page* 397)



Test it . . .
Consolidated Vultee did—
They found it all we claimed





You test it . . .
they did . . .
and found it worth-while

THE LOXIT SKIN FASTENER . . . was recently tested by laboratory technicians at Consolidated Vultee Aircraft Corporation, builders of the famous Liberator B-24 Bomber. Results substantiated every claim made.

SAFER . . . special design and rugged construction adds increased safety factor. Appeals to women workers.

FASTER . . . simply line up skin holes . . . compress . . . snap and it's in.

EASIER TO USE . . . LOXIT Skin Fasteners need to be held in compression only at instant of application. Motion studies show this saves 75% of worker fatigue and speeds operation an average of 10%.

LONG-WEARING . . . hardened steel body shell and heat-treated plunger reinforced by tubular sleeve increases life span.

SMALLER . . . easier to handle in close quarters, particularly near right angle bends.

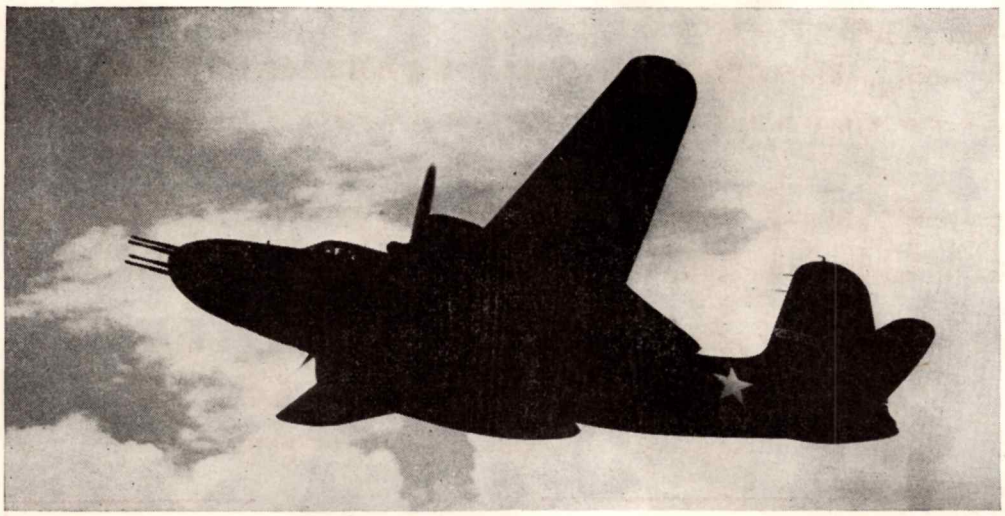
FREE SAMPLES

A request on your business letterhead will bring you LOXIT Skin Fasteners for your testing. You'll find it fits any standard type pliers or gun. Write today. Scovill Manufacturing Company, 21 Mill Street, Waterbury, Connecticut

LOXIT SKIN FASTENERS SPEED THE JOB
. . . A SCOVILL PRODUCT

HELPING TO SOLVE TODAY'S WARTIME PRODUCTION PROBLEMS

★★★



This version of the Douglas "Havoc" has greatly increased fire-power which puts it in the fighter-bomber class. Its silhouette is familiar on all warfronts; the enemy has a wholesome respect for it

(*Continued from page* 395)
stepped up to one day instead of the two days now required and will eliminate the need for the present overnight stopover at Port of Spain, Trinidad.

Business Reports

CONTINENTAL

Continental Air Lines for July reported passenger revenue increases of 128% over the same month in 1942, which topped June's record by 4½%. This represented the largest income month in the nine years of operation of the company.

Passenger revenue miles for July were 116% more than the similar period last year, and showed a 6½% increase over June. The airline's load factor was 46% more than that of July 1942 and recorded a 2.8% increase over the preceding month.

NORTHEAST

Northeast Airlines, Inc., reports an increase of 13% in the number of passengers carried during the first six months of 1943 as compared with the same period in 1942. Passengers flown totaled 13,200, a gain of 1523 over the 11,677 carried in 1942.

NORTHWEST

Northwest Airlines carried a new all-time record cargo of airmail during the month of July in the amount of 437,279 airmail pounds. This exceeded June by 46,000 lbs. NWA planes flew 327,273,663 pound miles in July, besting the June total by almost 50,000,000 pound miles.

UNITED AIR LINES

UAL has announced record figures for the first six months of this year, covering the regularly scheduled operations only and excluding the miles being flown for the Army Air Transport Command. At the end of June, the airline's revenue passenger miles totaled 158,363,757, an increase of 15% more than the same period in 1942. Express pound miles amounted to 3,632,644,103, a gain of 13% more than the 3,215,920,909 in the first six months of last year. Mail pound miles increased 82½% to total 9,717,100,596.

Due to the fact that the company is using fewer planes, revenue airplane miles flown in that period decreased 14½%.

TWA, INC.

Increases of 100% and 78% over the first six months of last year for air mail and express, respectively, carried by Transcontinental & Western Air, Inc., were reported at the end of June. Preliminary figures disclosed that air mail carried in the first half of 1943 amounted to 8,393,084 lbs against 4,188,936 lbs in the same period in 1942. Express totaled 3,425,051 lbs at the end of June, 1943 compared to 1,927,113 lbs last year.

Although revenue miles flown by the TWA fleet decreased 16%, revenue passenger miles totaled 106,628,252, an increase of more than 9% more than the 97,433,152 passenger miles for the first six months of 1942.

For the month of June, 1943, TWA carried 29,661 passengers, an increase of more than 25% over June, 1942, and flew 1,333,839 revenue miles, a gain of 13% more than last year. Mail and express pounds flown in June this year increased 121% and 66% respectively over June, 1942.

Western Feeder Line

Four newspaper and radio men are seeking authority from the CAB to operate a feeder line, the Sunshine Airlines, Amarillo, Tex., between 100 municipalities in Texas, Oklahoma, New Mexico and Kansas.

SCHOOL ACTIVITIES

Student Pilots Tested Amid Battle Sounds

Student pilots at Stewart Field, of the United States Military Academy where 183 cadets have completed basic training and have just entered advanced training school this month, received final examinations amid the din of battle noises. The students were given aircraft identification examinations in a classroom where a loudspeaker blared out the thunderous shrieks of an air raid, complete with sounds from dive bombers, zoom attacks and shouted commands of officers. For one-tenth of a second each tiny picture of an Allied or enemy aircraft was flashed upon a screen for identification by the men.

The new method of examination has been introduced with medical approval as one of the many new training methods being used by the instructors of the Wings of West Point, located 15 miles from the academy near Newburgh.

The flying cadets at the training school are under the direction of Col. George F. Schlatter, 34-year-old pilot-commander of the field. Director of the training program is Col. Benjamin Webster, who is 32 years old. An instructor is Maj. Everett W. Holstrom, 27 years old of Tacoma, Wash., who was the third pilot to take off in Maj. Gen. James Doolittle's Tokio raid. Formerly a Flying Tiger, Major Holstrom learned air tactics from Maj. Gen. Claire L. Chennault. Another instructor is 24-year-old Capt. Arthur E. Andres of Newton, Mass., a pursuit pilot, who was awarded the Distinguished Flying Cross for his action in the Pacific.

Helicopter Course Opens at NYU

The School of Aeronautics of New York University begins classes this month with courses emphasizing the helicopter in lieu of the autogiro. The lectures are designed to appeal to graduate students in aeronautical engineering; engineers in industry already engaged in helicopter work or seeking to qualify for entry in this field; for those interested in aircraft accessories or equipment to whom the helicopter has brought new problems and opportunities; to engineers working in the closely allied field of the aircraft propeller, and to mechanical engineers for whom the transmission and control of the helicopter have a decided interest.

The first term will cover fundamental conceptions and theory while the second term's work will interest those who wish to pass from the basic principles to application in general design, structural analysis, mechanical design and gain a more professional outlook on the helicopter.

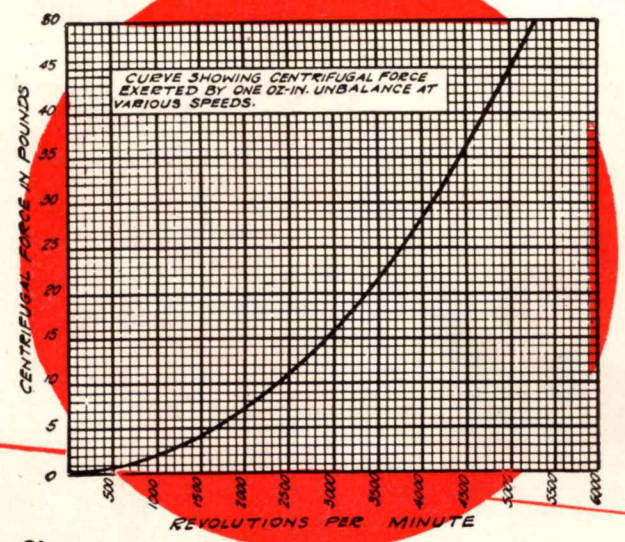
NYU Offers Course in Applied Aerodynamics

Engineers now in the aircraft industry are being given an opportunity to receive advanced instruction in the modern aerodynamical problems of airplanes, with special emphasis on wartime needs. The graduate division of the College of Engineering of New York University will begin a course in applied aerodynamics October 15 which will run through Feb. 4, 1944 at Adelphi College, Garden City, N. Y.

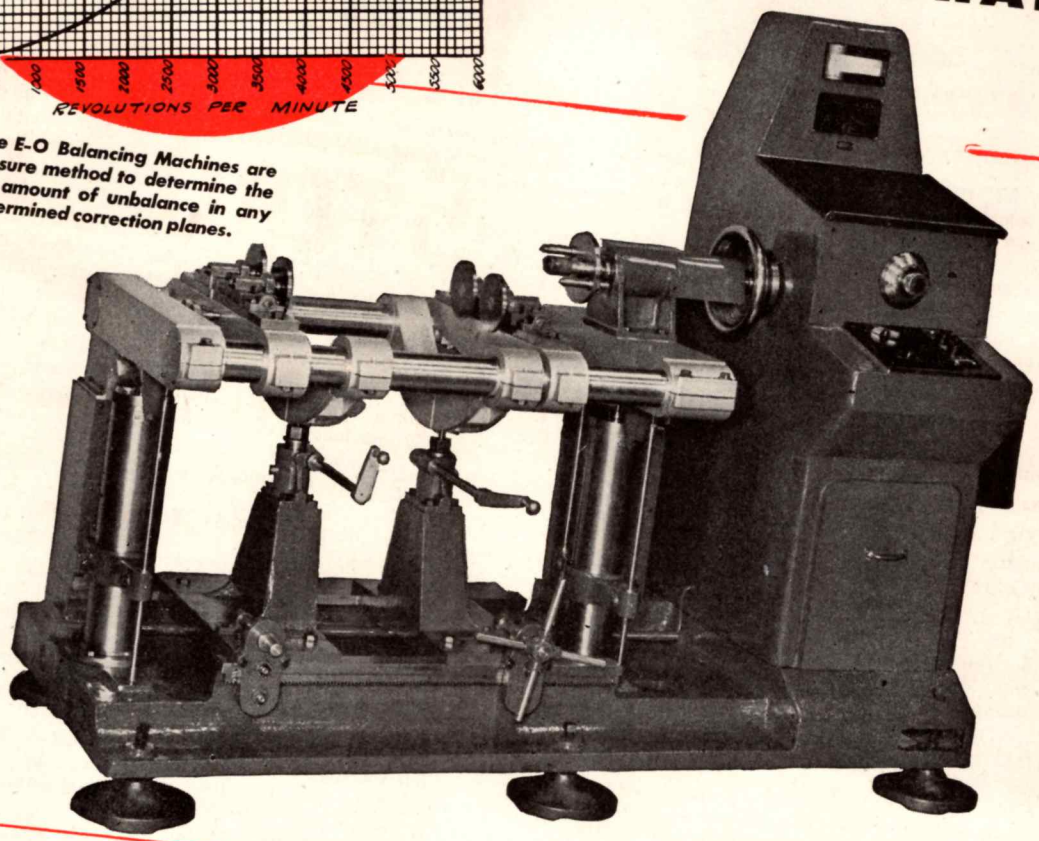
Open to qualified graduates of a college or technical school of equal standing to NYU's College of Engineering or College of Arts and Pure Science and have the prerequisites as listed in the graduate division bulletin, the course will carry three credits toward a higher degree.

(*Continued on page* 401)

OLSEN TYPE E-O for *Balancing* AIRCRAFT ENGINE CRANKSHAFTS



Olsen Type E-O Balancing Machines are the quick, sure method to determine the angle and amount of unbalance in any two predetermined correction planes.



Olsen Type E-O #3 Balancing Machine

Aircraft engine manufacturers are enthusiastic in their praise of the Olsen Type E-O Balancing Machine. Its inherent simplicity of design and high accuracy assure speed and ease of operation in determining the angle and amount of unbalance in any two predetermined correction planes.

Unbalance in the crankshaft vibrates the cradle, which in turn actuates a magnetic pick-up generating an alternating current output. A commutator rectifies this output and definitely determines the angular position of unbalance.

The meter reading on the E-O machine indicates the amount of unbalance on a linear scale which is easily calibrated to indicate in correction units.

Obviously, the E-O Balancing Machine is adaptable for balancing any rotating part within the range of the machine, such as supercharger impellers, armatures, etc.

For further information, write today for your copy of Olsen Bulletin 26 which describes in detail the design and principle of operation of Olsen E-O Balancing Equipment.

TINIUS OLSEN TESTING MACHINE CO.
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Balancing Machines AND PHYSICAL TESTING EQUIPMENT
Representatives: PACIFIC SCIENTIFIC CO., Los Angeles, San Francisco, Seattle
MINE and SMELTER SUPPLY CO., Denver, Colo.

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● 68 years of leadership in the manufacture of flexible shafting is your best assurance that STOW claims will become realities in actual service. When you specify STOW, you specify highest quality, longest life, best performance. Compare! Get all the facts. Write us for full description and nearest dealer's name.

● STOW Flexible Drill-Shafts, with straight spindle or angle heads, reach the hard-to-get-at spots. The handy way to drill *true* holes *fast*.

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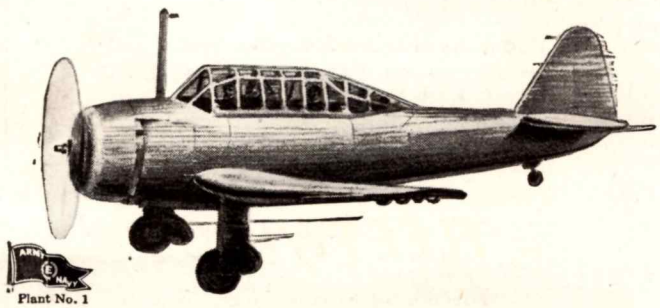
TAKE AWAY AIRPOWER!

TAKE away airpower, and the job of winning the war becomes terrifying in its immensity. Our strategy of fluidity, surprise, and preparatory softening would stagnate to one of position with military advances measured in feet instead of hundreds of miles. Everywhere on the globe, footholds in enemy territory would be gained only at calamitous loss of life.

Is it any wonder that America's eyes are turned skyward? Isn't it natural for us to depend on aviation to bring an earlier end to the war, and to assure the continuance of peace by making neighborliness the keynote of worldwide diplomacy? Airpower, a faint shadow over the world in 1918 has become the very substance of our hope today. It is the part of Fleetwings to vitalize that hope with its contribution of planes and plane parts.

Fleetwings-made wings, fins, stabilizers, ailerons, flaps, and hydraulic valves for America's fastest and best aircraft flow from the production lines in a floodtide . . . every part a promise of a better future—each piece an omen of our nation's permanent airmindedness. Fleetwings, like all industry, is in it for victory, but Fleetwings is in it too—for a sound and continuing peace.



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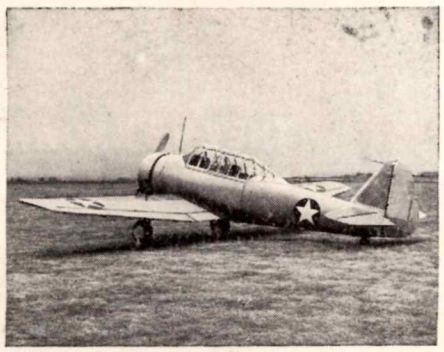
FLEETWINGS

pioneers with parts and hydraulic equipment



The BT-12, all-welded basic trainer built for the U. S. Army Air Forces.

WELDING SCHOOL GOES MODERN Because the old apprentice method of teaching welding was too slow for wartime production speed-up, Fleetwings' welding school has streamlined its course and is turning out first class welders in double-quick time. The whole subject of welding is taught thoroughly. Instructors insist that each worker understand the theory and principles of welding before doing any practical work. And, as a part of the training, students follow a regular welder through his routine work—learning first hand how welds should be made.

NEW IDEAS DEPARTMENT When the rivet sorting problem became acute at Fleetwings, the Special Tool Development Department came to the rescue with a sorting device guaranteed to save man hours aplenty. It's nothing but a turning barrel screen on the order of those used in collieries for grading coal. With it, one operator can match the turnout of twelve workers using the old hand sorting system.

HYDRAULIC VALVE DIVISION Fleetwings pioneered in the aviation valve industry for its own ships and is still pioneering in production methods and shortcuts. As war work multiplies, Fleetwings' hydraulic valve division follows through with greater precision and finer craftsmanship. Watch for the announcement of a new group of slide selector valves.

THE ARROW, Fleetwings' monthly magazine, will help you to keep informed. In its pages are described the new production methods, shortcuts, and news of interest to men and women in the aircraft industry. If you'd like to receive a copy each month, write us on your company stationery. Send your request to "THE ARROW," Fleetwings, Inc., Bristol, Pa., Plant No. One.

FLEETWINGS

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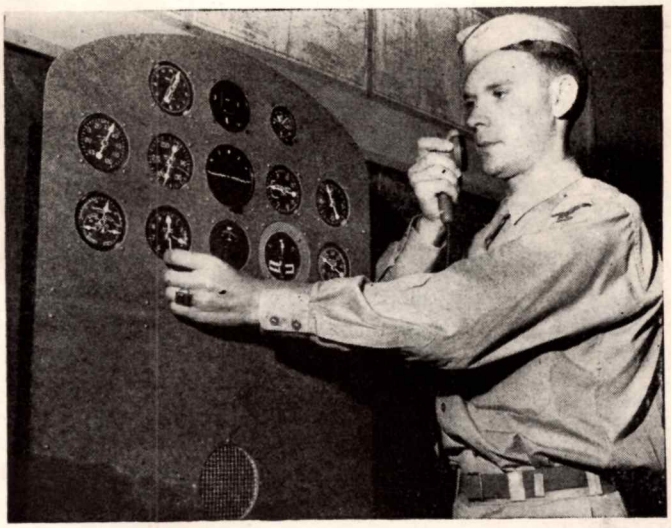

Device which permits individualized training on instrument and range flying to an entire class at one time employs a combination Link and AT-6A instrument panel. It was developed by Melvin K. Lyster, Southwest Airways instructor

(*Continued from page* 397)

The syllabus of lectures is to cover the following subjects: Compressibility, Compressibility related to the V. G. diagram and stress analysis, Introduction to flutter definition of modes of oscillation, Stability and maneuverability, Reduction and corrections in performance tests, and inter-relation of thermodynamic and aerodynamic effects.

Parks Plans Post-War Program

A group of officials of Parks Air College are meeting regularly to plan for the institute's activities after the war. In the head offices of the college, and its branches located at Alabama Institute of Aeronautics, Mississippi Institute of Aeronautics, Missouri Institute of Aeronautics, and Cape Institute of Aeronautics, the heads have pledged 20% of their time toward the goal of considering, analyzing and securing the best possible information on the aviation into which Parks' five institutions may turn their efforts at the war's end.

United Awards Scholarships

United Air Lines has awarded 135 teachers of aviation subjects scholarships to carry on aviation research or study special aviation education courses. The men and women are enrolled at 22 colleges and universities throughout the country.

The grants for students in schools of education allow school and college teachers to make evaluations of material for aviation courses, to develop material for laboratory experiments and to compile teaching units in aviation ground mechanics for physics courses. Provided by airline's Fund for the Advancement of Aviation Education, the grants are awarded for particular projects undertaken by the schools.

Woodworkers School Producing Gliders

A new course in the construction of gliders in accordance with United States Army specifications is being offered at the White Plains, N. Y., War Production Training School under the direction of Dr. L. Paul Miller.

The school was opened in answer to the demand for workers trained in aircraft woodwork needed to produce gliders for military service. Approximately 400 hours of training is required for glider woodwork.

University Graduates 130 Aviation Teachers

A group of newly qualified teachers of aviation studies will instruct in schools throughout the nation this fall. Under the direction of Sister M. Aquinas, the Catholic University in Washington, D. C. has graduated in aeronautical subjects a class of 130 teachers from 20 states.

The courses included aircraft, structure, elementary aerodynamics, principles of flying engines, meteorology, aviation radio and communications. The student teachers received practical knowledge through the facilities of the Washington National Airport, supplemented with classroom activities in preflight elementary and secondary school practice.

They're Vital to the Aircraft Industry

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BURRING is an important finishing operation on thousands of aircraft parts—both in the airframe plants and the motor plants. And many of these burring operations are being done with Norton Mounted Points and Mounted Wheels.

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TREND of INVENTION

These patents, of interest to the aeronautical industry, were compiled from recent issues of the *Official Gazette* of the U. S. Patent Office. Copies of the individual patents, in pamphlet form, may be obtained from the Commissioner of Patents, Washington, D. C., at a cost of ten cents each

Airplane Package Transfer Apparatus. Roy L. Cooper, Sheffield, Ill. (22,351)

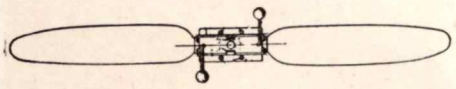
Adapter for Mounting Machine Guns. Frank M. Salisbury, Kenmore, N. Y., assignor to Bell Aircraft Corp., Buffalo, N. Y. (22,361)

Design for a Bombardment Airplane. Paul H. Kemmer, Patterson Field, and Charles S. Butt, Jr., and Carl E. Reichert, Dayton, Ohio. (135,852)

Design for an Amphibian Airplane. Adam J. Stolzenberger, Jr., Glendale, Long Island, N. Y. (136,075)

Heating System. Harry Giffords, New York, N. Y. (2,314,086)

Engine Starting Mechanism. Sidney H. Webster, Bogota, N. J., assignor to Bendix Aviation Corp., South Bend, Ind., a corporation of Delaware. (2,322,608)

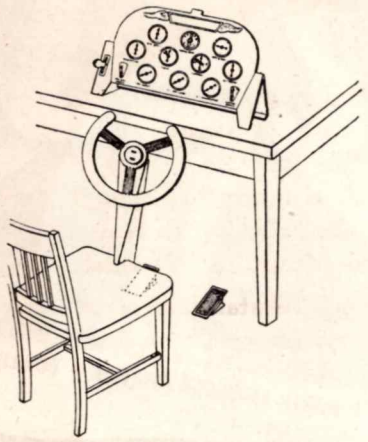


2,324,569

Covering for Airfoil Surfaces. William Harper, Jr., Montreal, Quebec, Canada. (2,322,632)

Valve. John William Overbeke, Anneslie, Md., assignor to The Glenn L. Martin Co., Baltimore, Md. (2,322,658)

Aircraft. Theodore Kloren, Philadelphia, Pa. (2,322,715)



2,324,833

Lateral Control for Aircraft. Francis Melvin Rogallo, Hampton, Va. (2,322,745)

Airplane Propeller. William Martino, Detroit, Mich. (2,322,763)

Airplane Landing Gear. Edward M. Bertran, Jackson Heights, N. Y., assignor to Brewster Aeronautical Corp., Long Island City, N. Y. (2,323,367)

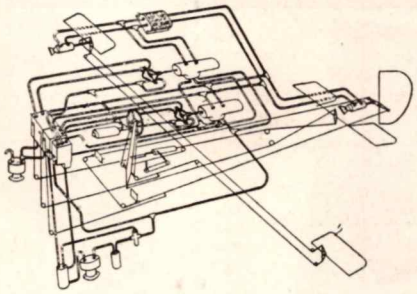
Means for Destroying Aircraft. Phil F. Newman, Blackwell, Okla. (2,323,561)

Means for Reproducing Motion. Joel D. Peterson, Ridgewood, N. J., assignor to Bendix Aviation Corp., Bendix, N. J., a corporation of Delaware. (2,323,566)

Valve for fuel tanks. Arthur L. Parker, Cleveland, Ohio. (2,324,464)

Propeller. Walter W. Everts, Baltimore, Md., assignor to Everel Propeller Corporation, Baltimore, Md., a corporation of Maryland. (2,324,569) (See illustration)

Rotative Winged Aircraft. Agnew E. Larsen, Jenkintown, Pa., assignor to Autogiro Company of America, Willow Grove, Pa., a corporation of Delaware. (2,324,588)



2,325,108

Sheet Metal Adjusting Nut or the Like. George A. Tinnerman, Cleveland, Ohio, assignor to Tinnerman Products, Inc., Cleveland, Ohio, a corporation of Ohio. (2,324,653)

Educational Airplane-Cockpit Outfit. Sam Gold, Chicago, Ill., assignor to Einson-Freeman Co., Inc., Long Island City, N. Y., a corporation of Delaware. (2,324,833) (See illustration)

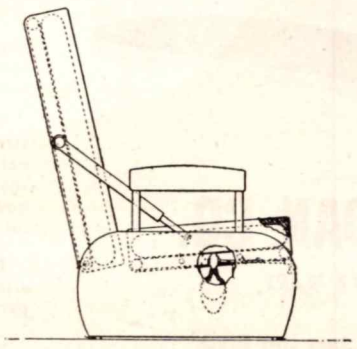
Airplane Brake. James W. Hatch, Akron, Ohio, assignor to The Firestone Tire & Rubber Company, Akron, Ohio, a corporation of Ohio. (2,324,979)

Aircraft Control Device. Bert G. Carlson, Erieside, Ohio, assignor to Jack & Heintz, Inc., Bedford, Ohio, a corporation of Ohio. (2,325,108) (See illustration)

Pneumatic Cushion. Marshall L. Brewstern, Van Nuys, Calif. (2,325,223) (See illustration)

Electrical Connector. Clinton B. Gaty, Jamaica, N. Y., assignor to Fairchild Aviation Corporation, Jamaica, Long Island, N. Y., a corporation of Delaware. (2,325,313)

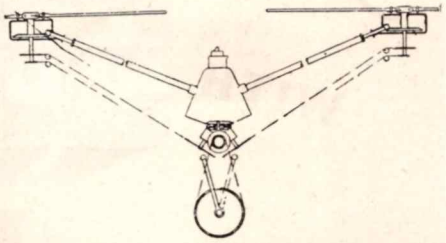
Engine Starter Gearing. Burr W. Jones, Elmira Heights, N. Y., assignor to Bendix Aviation Corporation, South Bend, Ind., a corporation of Delaware. (2,325,518)



2,325,223

Control Means for Rudders and the Flaps Thereon. Helmut Roos, Johannes Dorr, and Wilhelm T. Koch, Dessau, Germany; vested in the Alien Property Custodian. (2,325,548) (See illustration on page 405)

Glider Launching Device. James N. Petty, Maricopa County, Ariz. (2,325,630) (See illustration on page 405)



2,325,632

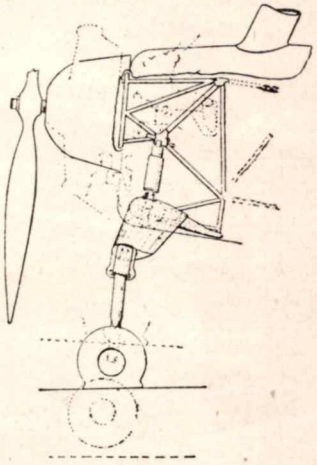
Rotary Wing Aircraft. Cyril George Pullin Genista, Newton Mearns, Scotland, assignor to Autogiro Company of America, Willow Grove, Pa. (2,325,632) (See illustration)

Airplane Construction. Joseph K. Anderson, Painesville, Ohio. (2,325,900)

Fuel Feeding Device for Aircraft. Rifat Avigdor, Leaside, Ontario, Can. (2,325,931)

Brake. Frederick C. Frank, South Bend, Ind., assignor to Bendix Aviation Corp. (2,325,944)

Airplane Carrier and Seadrome. Carl M. Zoll, Dundalk, Md., assignor to Universal Hydraulic Equalizer, Inc., Dundalk, Md. (2,325,993)



3,326,210

Landing Gear of Aircraft. George Herbert Dowty, Cheltenham, England. (2,326,019)

Aircraft Landing Gear. George Herbert Dowty, Cheltenham, England. (2,326,020)

Gas Turbine Plant. Claude Seippel, Ennetbaden, Switzerland, assigned to Aktiengesellschaft, Brown, Boveri & Cie., Baden, Switzerland. (2,326,072)

Multidrive Airplane. Jerry Petrich, New York, N. Y. (2,326,104)

Distributor. Emil Zoerlein and Johannes E. Hoffmann, Dearborn, Mich., assignors to Ford Motor Co., Dearborn, Mich. (2,326,113)

Engine Starting Apparatus. Lawrence C. Dermond, Anderson, Ind., assignor to General Motors Corp., Detroit, Mich. (2,326,125)

Lubrication of Aero and Other Engines.

(*Continued on page* 405)

Versatility Unlimited

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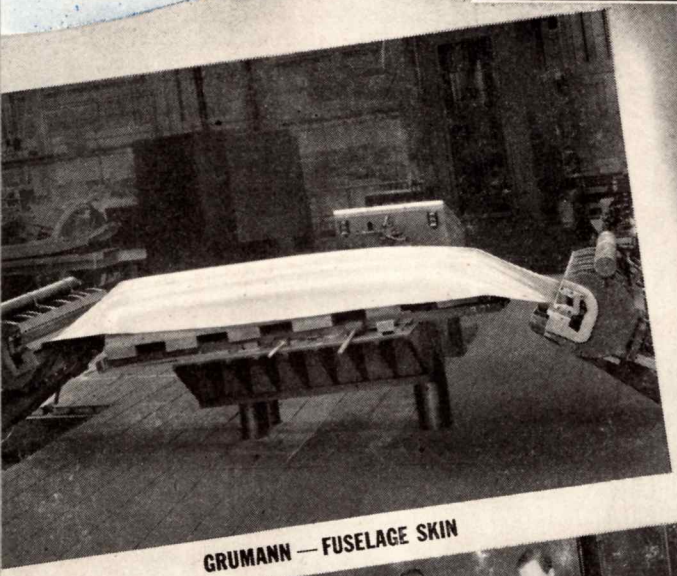
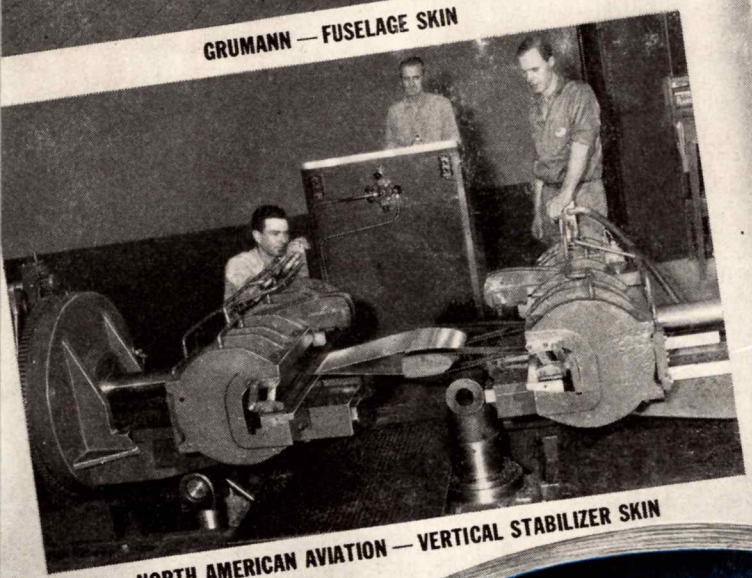
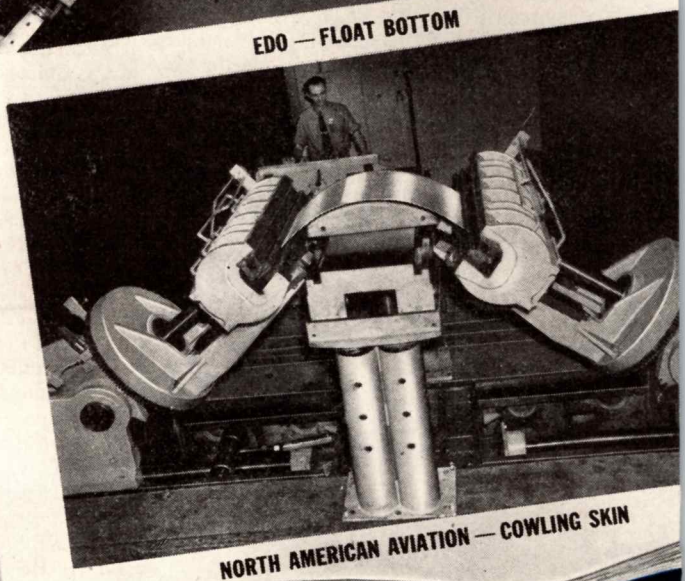


GRUMANN — FUSELAGE SKIN



NORTH AMERICAN AVIATION — VERTICAL STABILIZER SKIN

EDO — FLOAT BOTTOM



NORTH AMERICAN AVIATION — COWLING SKIN

These installations of SHERIDAN sheet stretchers in leading aircraft plants partially demonstrate the wide scope and versatility of these practical machines.

SHERIDAN makes the only hydraulically operated stretcher capable of handling flat sheets for longitudinal stretching up to a length of 22'3". Numerous unusual shapes in between that maximum (upper right photo) and small leading edge skins (lower left photo) can be formed.

There are also a number of SHERIDAN *extrusion* stretchers installed in aircraft plants producing extruded parts in a wide range of shapes and sizes.

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Rickmansworth, Herts
England

(*Continued from page* 403)

Emile Piquerez, Saint-Cloud, France, vested in alien property custodian. (2,326,167)

Fuel Injection Device. Ferdinand Carlo Reggio, Detroit, Mich. (2,326,171)

Aircraft Landing Gear. Adolph C. Falk, Drexel Hill and Robert A. Wagner, Sharon Hill, Pa., assignors to Kellet Autogiro Corp. (2,326,210) (See illustration on page 403)

Internal Combustion and Apparatus Thereof. Alfred M. Thomsen, San Francisco, Calif. (2,326,266)

Control for Variable Pitch Propellers. Hans Reissner, Chicago, Ill. (2,326,308)

Crystal Working Apparatus. Richard S. Bailey, Baltimore, Md., assignor to Bendix Aviation Corp., South Bend, Ind. (2,326,319)

Internal Combustion Engine. Joseph O. Camp, Oak Park, Ill. (2,326,329)

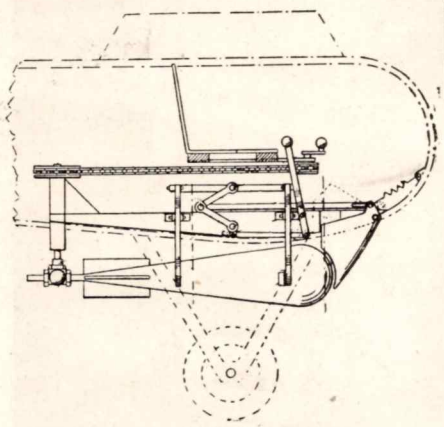
Radio Compass Direction Finder. Simon DiRenzo, Philadelphia, Pa. (2,326,337)

Solenoid Seitch. Louis B. Ehrlich, Toledo, O. (2,326,342)

Propeller Manufacture. Werner J. Blanchard, Dayton, O., assignor, by direct and mesne assignments, to General Motors Corp. (2,326,430) (See illustration)

Radial Cylinder Motor and the Like. Dudley George Jones, Aldwych, London, England. (2,326,464)

Shock Absorber. Bonnie L. Mallory, Cleveland, O. (2,326,665)



2,325,630

Navigaton Trainer. Carl J. Crane, Shreveport, La. (2,326,764)

Radio Beam Training Device. Arthur H. Delareuelle, United States Marine Corps, and Harry Price, Uinted States Navy. (2,326,766)

High Grade Motor Fuel from Straight Run and Similar Hydrocarbons. Eugene J. Houdry, Ardmore, Pa., assignor to Houdry Process Corp., Wilmington, Del., a corporation of Delaware. (2,326,779)

Internal Combustion Engine Control. Harold W. Meade, Covington, Ind. (2,326,791)

Multiple Launching of Parachute Borne Equipment Containers from Aircraft. Harry Wilson, Fort Benning, Ga. (2,326,813)

Airplane. Donovan R. Berlin, Eggertsville, N. Y., assignor to Curtiss-Wright Corp., a corporation of Delaware. (2,326,819)

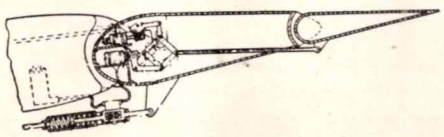
Artificial Horizon. Leslie F. Carter, Leonia, N. J., assignor to Sperry Gyroscope Co., Inc., Brooklyn, N. Y., a corporation of New York. (2,326,835)

Aircraft Gun Mount. Clem G. Trimbach, Eggertsville, N. Y., assignor to Curtiss-Wright Corp., a corporation of Delaware. (2,326,904)

Airship. Victor M. Van Gieson, Albuquerque, N. Mex. (2,327,145)

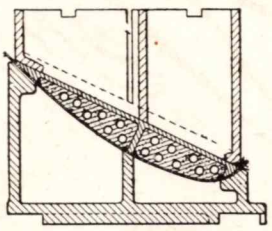
Aircraft Control Device. Bert G. Carlson, Erieside, Ohio, assignor to Jack & Heintz, Inc., Bedford, Ohio, a corporation of Ohio. (2,327,171)

Aircraft Heating Apparatus. Henry J. De N. McCollum, Chicago, Ill. (2,327,202)



2,325,548

Variable Pitch Propeller Control Mechanism. Harry P. Reiber, Willamsport, Pa., and



2,326,430

Jack B. Reiber, Ann Arbor, Mich., assignors of forty per cent to Arthur H. White, New York, N. Y. (2,327,217)

ACME PHOTO

"DEAD BIRD!" DEAD SHOT...DEAD JAP

Skeet shooting is an essential part of Army and Navy training for Air Force gunners. To protect their eyes, student aviators wear Ray-Ban sunglasses—favorite of skeet shooters before the war. In full sunlight, their eyes are relaxed, comfortable — glare-producing rays cut to a minimum by Ray-Bans' filtering glass. Vision of the target is sharp, clear, because Ray-Bans transmit most of the light useful for seeing.

Wherever sun-glare can harm precious eyes, Ray-Ban lenses are being used by the armed forces to protect that eyesight—in pilot training, on Ferry Command, at ships' lookout stations, plane spotting posts, for tank crews. Ray-Bans essential for civilian work, are available *on prescription only.*

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The prints are in full color on a heavy paper stock suitable for framing. They're 24 x 22 inches in size and free from advertising. They're shipped in a special mailing tube. If you wish one, may we suggest that you order your copy at once, enclosing the nominal sum of 10c to cover mailing cost? Address your request now to Studebaker, South Bend 27, Indiana.

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Studebaker's war job is producing ever-increasing quantities of Wright Cyclone engines for the Boeing Flying Fortress—big, multiple-drive military trucks—other vital war matériel. We are proud of our assignments in the arming of our Nation and its Allies.

Studebaker BUILDS WRIGHT CYCLONE ENGINES FOR THE BOEING **Flying Fortress**

Design

Armored Aviation — Aeronautics, *Vol. 8, N.4, May 1943.*

It is interesting to note that the article, as stated by the editor, is written by a skilled operational pilot and hence must be regarded as based on the most recent available war experience. That the present day weapons are interdependent one accepts without any question—it is to the credit of General deGaulle that he enunciated this principle back in 1933.

The design described in the article is what we once knew as the ground attack airplane. The author specifies that it will be required to fulfil five chief functions: (1) In case of invasion it will break the first onrush of the enemy by low flying attack, (2) it will specialize in cannon assault upon enemy tanks, (3) it will accompany tank units with the object of clearing the way for their advance, (4) it will harass the rearward elements of the enemy forces by disorganizing his communications, (5) it will undertake special reconnaissance, such as, low flying photographic work when the conditions prevent or impede the normal reconnaissance.

As proposed by the author the weight empty would be about 4950 lbs and the payload would be 4640 lbs. The payload distribution is as follows: pilot with parachute 198 lbs, two cannons (in wings) with ammunition 528 lbs, two machine guns (in fuselage) with ammunition 110 lbs, one cannon (in propeller hub) with ammunition 220 lbs, 132 gals of fuel 990 lbs, oil 110 lbs, bombs (for normal operating range) 440 lbs, radio 44 lbs.

War Gliders

Gliding into Battle. Captain R. G. Collins. Aeronautics, *Vol. 8, No. 1, February 1943.*

There is a great deal of speculation and debate on the value of gliders as a military transport and on the relative merits of paratroops and glider borne troops. Both German and Japanese have used airborne forces to achieve bridgeheads which paved the way for successful occupation of islands.

The capture of Crete by the Germans was almost entirely an airborne operation. The employment of gliders definitely offers an opportunity of making available considerably greater striking power and hence would seem to be preferable for daylight operations.

The author is somewhat cautious in this regard and apparently feels that paratroops have a better opportunity to assure surprise. The article devotes an equal amount of discussion to the airborne infantry and to the paratroops.

Night Vision

Night Blindness. J. Bennett. Aeronautics, *Vol. 8, No. 1, February 1943.*

The importance of night vision is well appreciated by everyone and it is generally known that vitamin A constitutes the essential element in this connection. The article reviews the subject of night vision and the two factors essential for night flying fitness, namely, good vision and good dark adaptation.

As is to be expected, altitude has a deleterious effect on night vision and hence night pilots must resort to the use of oxygen at lower altitudes as compared to standards applicable for daylight flying.

Floats

The Uniformity of the Stream Issuing from A Venturi Flume. A. M. Binnie, M. A. British Ministry of Aircraft Production Reports and Memoranda *No. 1886.*

The suggestion has been made that model seaplane floats could be tested by holding them stationary in the stream of water issuing from a Venturi flume. It is necessary that the flume should be built with vertical sides and a horizontal bottom, and that the water level downstream should be unobstructed.

The theory of the flow through this arrangement indicates that the depth and velocity of the issuing stream should be uniform, but it is an approximate theory only, and therefore the experiments described in this paper have been carried out on a considerable scale to check its accuracy.

It was found that at the beginning of the parallel part of the flume, a standing wave sprang from both sides and between these waves lay a smooth triangular space in which a model might be held. The base of this area was the width of the flume, and its apex lay on the centerline about 6½ ft downstream when the greatest available head was employed. In this useful zone the velocity was steady and uniform except near the bottom of the flume, but the surface was not absolutely flat.

Quantitative tests with a totally or deeply submerged model should therefore be satisfactory, but not with a lightly skimming model. For the latter case the flume might be of value for the study of the waves thrown up. The flatness of the stream might be improved by fitting the flume with an adjustable bottom.

Engine Testing

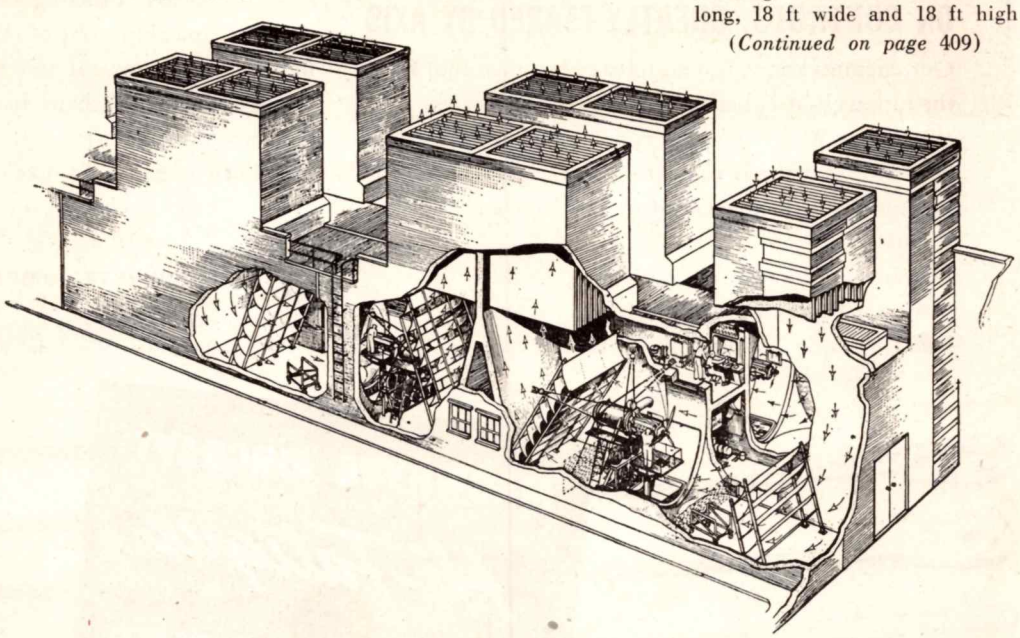
Engine Testing. Specially Built, Multi-cell Houses for Routine Tests. F. C. Sheffield. Aircraft Production, *Vol. V, N.55, May 1943.*

At the start of hostilities, Roates Securities, Ltd. were given among other projects, the repair and complete overhaul of engines in commission with the RAF. Two factories were selected to deal respectively with air and liquid-cooled types and for each a new test house was required to be built.

To balance repair facilities, eight test-cells were necessary in each case, and in neither was it evident to erect them alongside the main plant. It was thus possible to design the test houses as independently-sited, self-contained units.

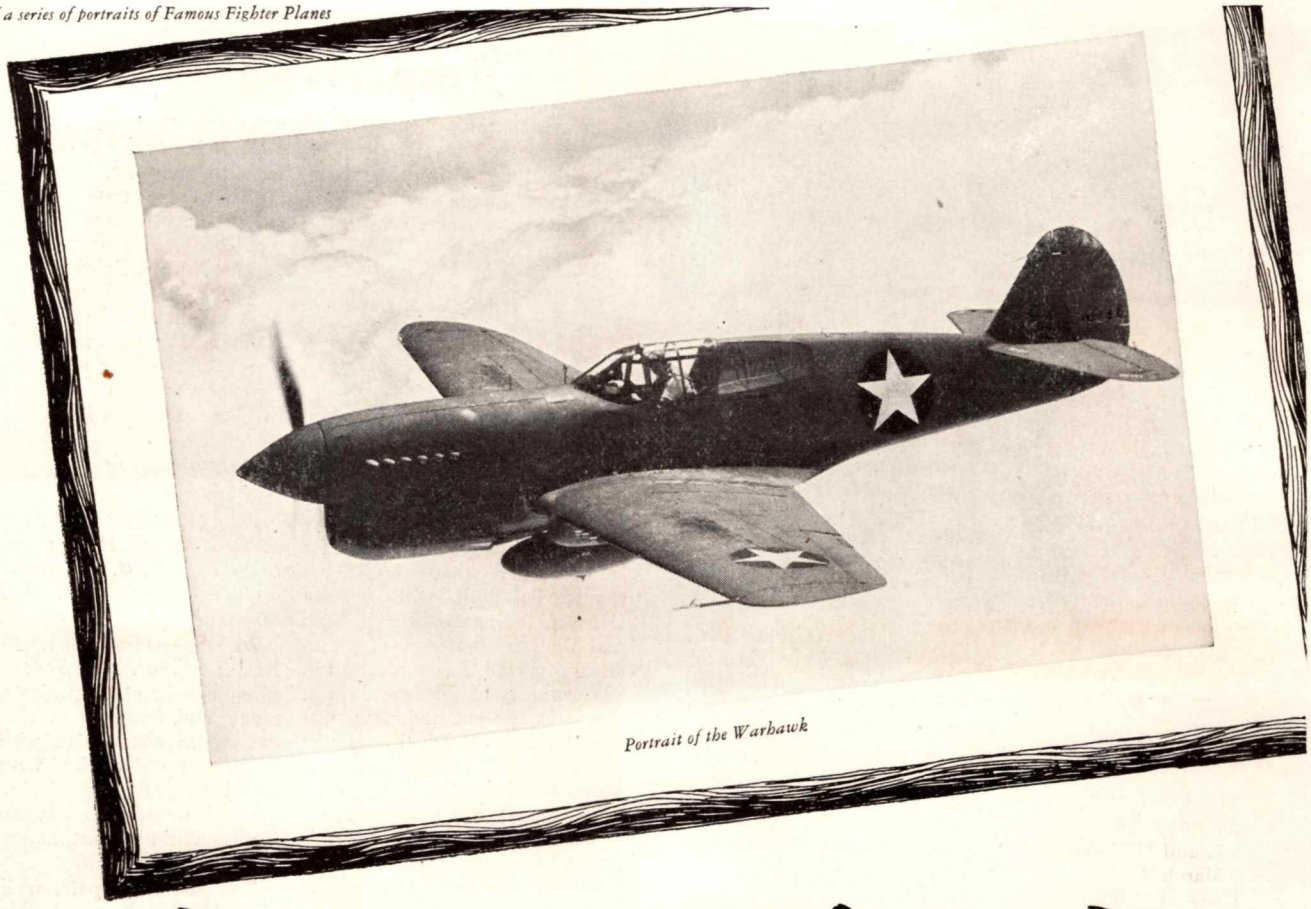
Albert Kahn, Inc. of Detroit was commissioned to design the building. The cells 71 ft 6 in long, 18 ft wide and 18 ft high

(*Continued on page* 409)



This part-sectioned schematic drawing shows the main features of the test-house. The air-intake and exhaust stocks of adjacent cells on each side are paired to minimize interference of flow. On the near side, engines are being made ready for test whilst an engine is being run in the end cell on the far side. In the foremost cell the location of the steel roller shutters is indicated in dotted line

One of a series of portraits of Famous Fighter Planes



Portrait of the Warhawk

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NO. 690-A

(*Continued from page* 407)
are arranged in parallel lines of four on each side of a common transit corridor. From the ends of each cell extend vertical air intake and exhaust stacks to a total height of 54 ft.

Immediately above the transit corridor is the control corridor where all the test instruments are located. Cells, corridors and stacks are constructed entirely of reinforced concrete in a single block, approximately 10,000 tons of prepared concrete being used in each test house. The details of arrangement and test equipment are described in sufficient detail to give a comprehensive picture of the Roates engine testing facilities.

Stratosphere

Stratosphere Research. Functioning of the Human and Mechanical System under Simulated Flight Conditions, Flight, *Vol. XLIII, No. 1795, May 1943.*

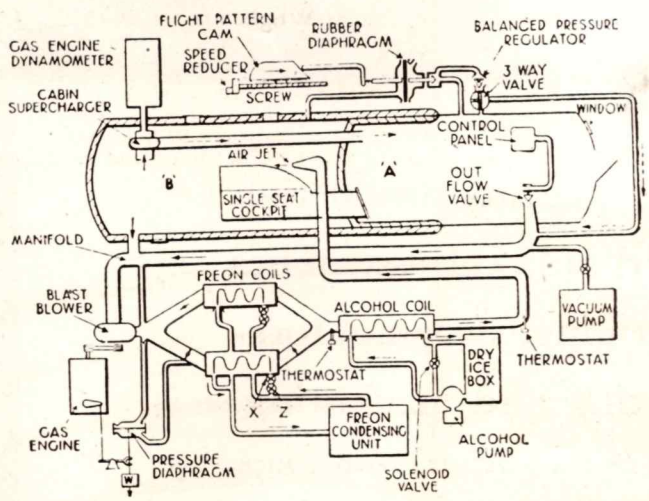
Previous articles in this series have dealt with "Fundamental Problems". (February 18, 1943 issue), "The Effect of Height on the Human Body" (February 25, 1943 issue), and "Pressure-Cabin Design" (March 4, 1943 issue). On the basis of British experiments, the official ruling is that oxygen must be used "at all heights above 10,000 ft and from ground level when the rate of ascent is 2000 fpm or more." It was found that unconsciousness occurs in the majority of subjects at an altitude of between 22,000- and 26,000 ft after a period of 35 min from the beginning, if the following rates of ascent are used: 0 to 10,000 ft at a rate of 2000 fpm; 10,000 to 15,000 ft at a rate of 1000 fpm, and 15,000 ft upwards at a rate of 500 fpm.

Overtones

Methods for Calculating the Frequencies of Overtones.—W. J. Duncan, Wakefield Professor of Aeronautics at University College, Hull, and D. D. Lindsay—British Ministry of Aircraft Production, Reports and Memoranda *No. 1888.*

There is no difficulty of principle in obtaining the frequencies of the overtone vibrations of elastic bodies by means of the well known Rayleigh-Ritz and Galerkin methods. It is necessary to use not less than $(r+2)$ independent displacement functions when it is desired to obtain the frequency of the rth overtone with satisfactory accuracy. The work entailed in solving $(r+2)$ simultaneous equations containing a frequency parameter by the ordinary methods, when r exceeds *1*, is excessive, and it is therefore desirable to find some method or device by which the labor may be reduced. One such device consists in solving the set of equations yielded by the Rayleigh or Galerkin methods by the application of the iterative matrix solution and an example of this is given.

The advantage of the matrix process becomes more pronounced as the number of equations in the set increases, but the method cannot be used until the rules for the basic arithmetical operations with matrices have been mastered; these are in fact simple and can easily be learned by those having no knowledge of the mathematical theory of matrices. Here also, an easy process is formulated for obtaining overtone frequencies without recourse to matrices. This has been done by making use of the orthogonal properties of the modes.



General layout of the Lockhead pressure chamber, 24 ft long by 6 ft in diameter. Compartment A simulates the aircraft cabin while compartment B simulates the atmosphere

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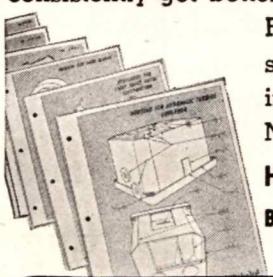

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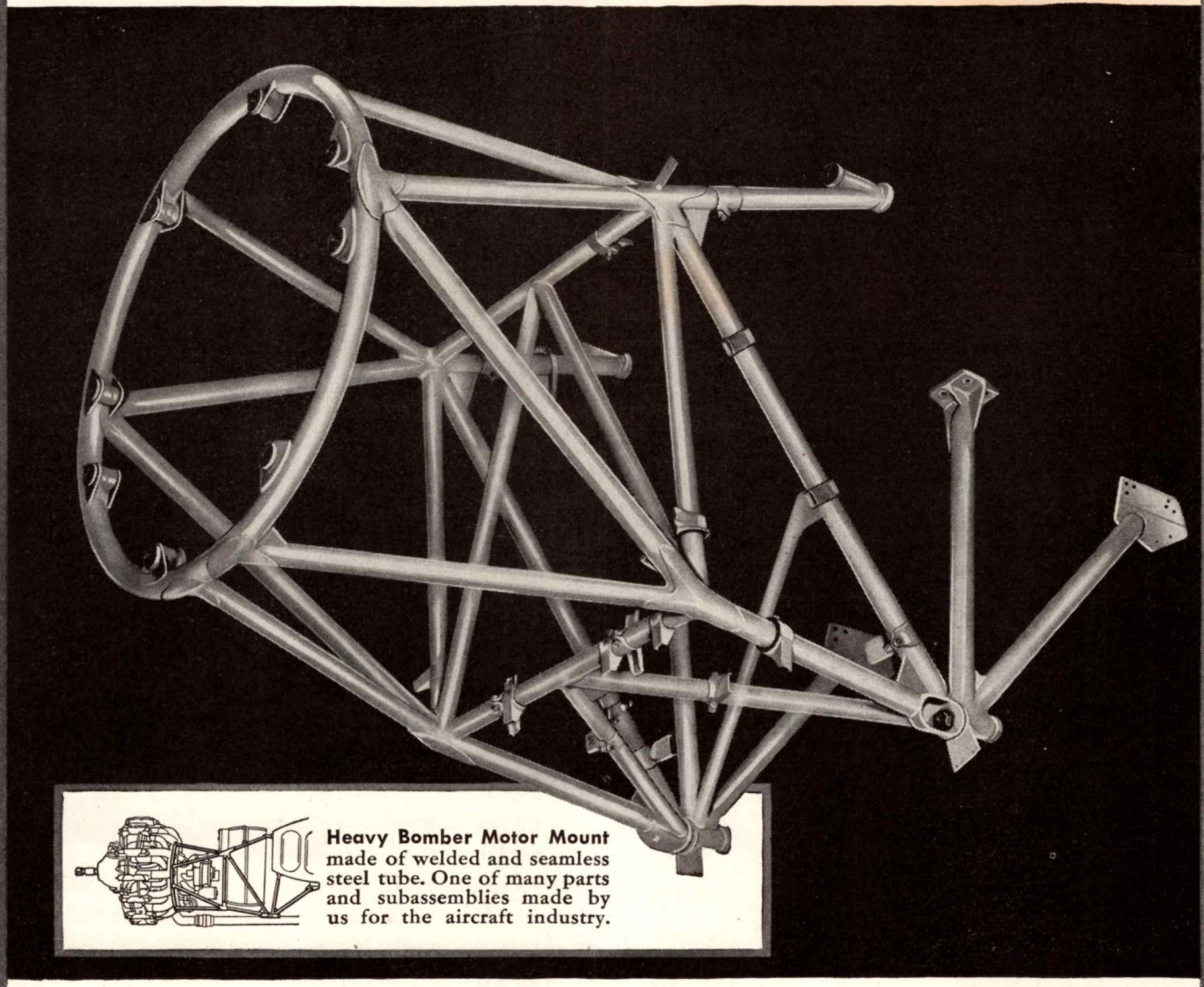

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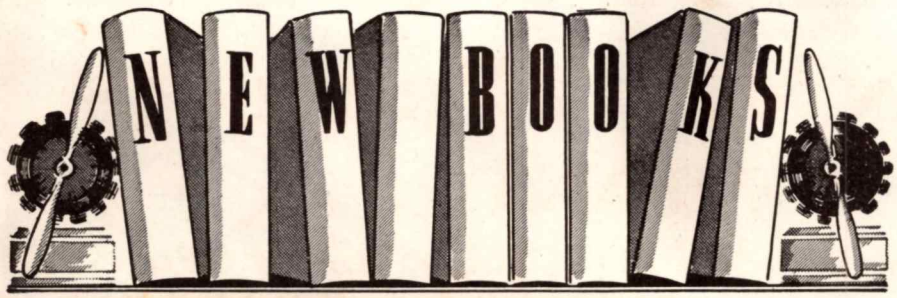

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Aircraft Lofting and Template Layout with Descriptive Geometry. Howard Thrasher. 212 pp.; $3.50.

For the student draftsman and engineer. Especially useful for those concerned with the manufacturing of products of sheet metal.

Airplane Design Manual. Frederick K. Teichmann. 440 pp. including index and bibliography; illus.; $4.50.

Of practical use to those who have experienced difficulty in coordinating their knowledge and efforts in the problems of actually beginning the design of a new aircraft and carrying on the work systematically.

Industrial Radiology and Related Phenomena. H. M. Muncheryan. 539 pp. including index; $7.50.

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Before You Fly. Pearl Thurber Robinson, Frederick A. Middleton, Dr. George M. Rawlins, Jr. and Maj. Joseph W. Phillips. 640 pp.; illus.; $2.75.

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Modern Trigonometry. M. J. G. Hearley. 168 pp.; $1.75.

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Elements of Mechanical Vibration. C. R. Freberg and E. N. Kemler. 193 pp. including index and bibliography; diagrams; $3.00.

A detailed discussion of the more elementary phases of vibrations presented in a form in which they can readily be applied to everyday problems.

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Basic Mathematics for Pilots and Flight Crews. C. V. Newsom and H. D. Larsen. 162 pp.; 39 illus.; $2.00.

Presents problems the pre-flight cadet will face, along with practical applications to be encountered in actual flight. Valuable chapter on the use of circular slide rule and the Dalton computer.

Air Navigation. E. R. Hamilton. 191 pp.; 87 illus.; $2.00.

Written in a simple and practical style, this book carries the reader of general background on to a thoroughly scientific understanding of the subject.

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Ground Instructor. (3rd Revised Edition) Charles A. Zweng. 336 pp. including index; illus.; charts and line drawings; $3.00.

Provides material covering ground instructor basic course. Especially valuable to commercial or private pilot in preparing for government examination. This revised edition covers new weather code.

Mechanical Vibrations. R. K. Bernhard. 149 pp.; 65 illus.; $3.00.

Methods of design and construction to cope with mechanical vibrations. Refresher for the practicing engineer. Includes an extensive bibliography.

Aircraft Descriptive Geometry. Walter Vaughn. 200 pp. including index; $3.50.

Illustrates and explains practical methods for the solution of descriptive geometry problems as applied to the airplane. Good reference book for designers, draftsmen, loftsmen, and mechanics.

Miscellaneous

The Navy Has Wings. Fletcher Pratt. 240 pp.; 32 pp. Official Navy Photographs; $2.75.

A detailed picture of the Naval Air Arm, describing and evaluating the role of aviation in the operations of the fleet.

Malta Spitfire. George F. Beurling and Leslie Roberts. 235 pp.; $2.50.

A fighter pilot's story of the defense of the most bombed patch of ground in the world. Told in terms of human courage, skill and heroism by a modern air fighter.

Aircraft & Engine Mechanics Manual. (2nd Revised Edition) Charles A. Zweng. 192 pp. including index; diagrams and tables; $3.00.

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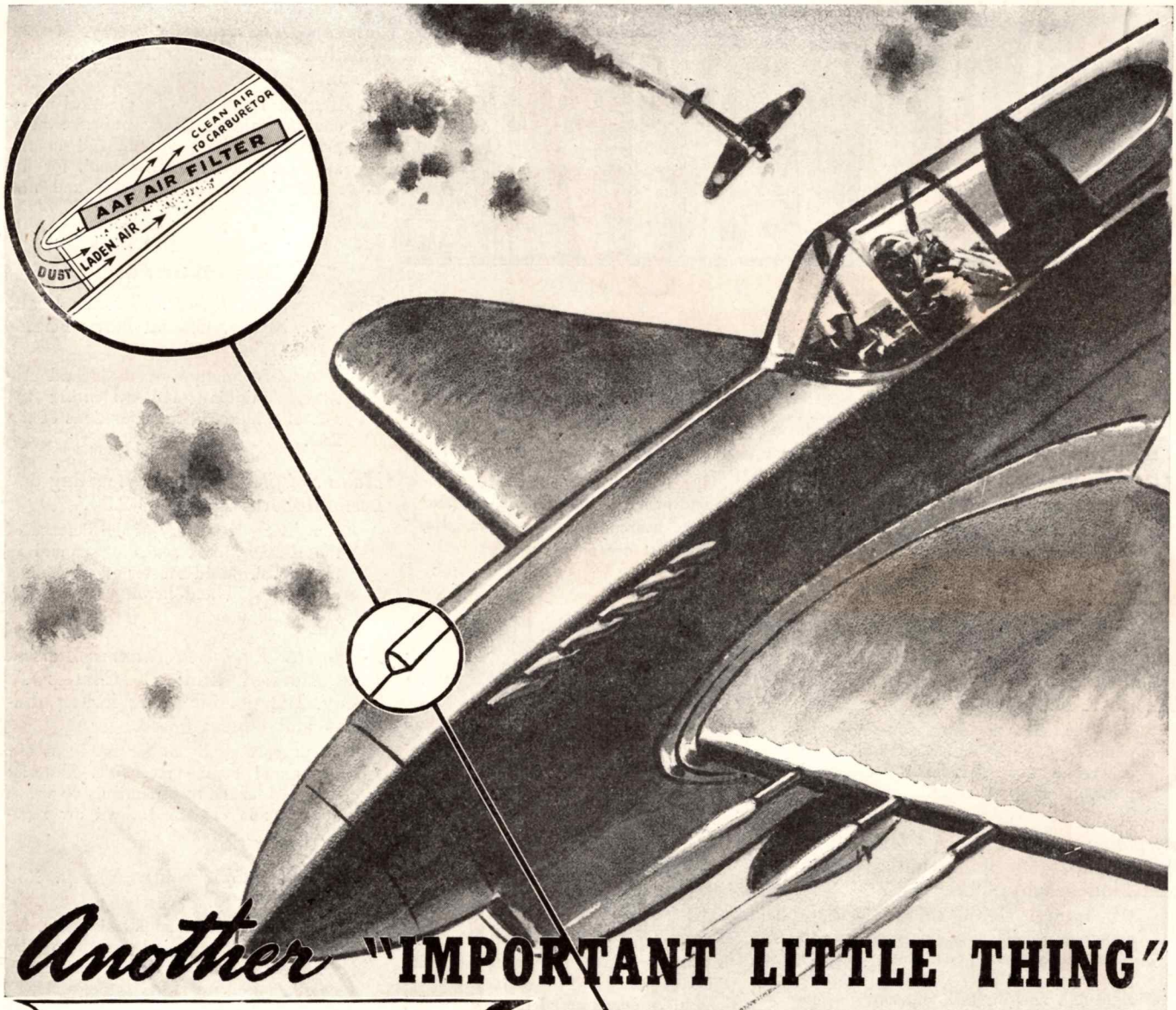

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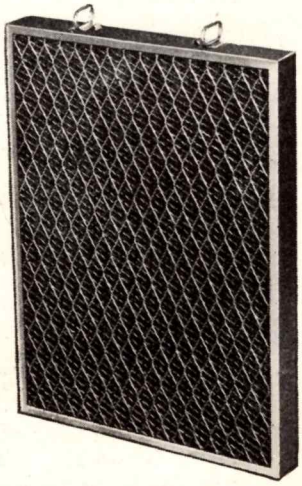

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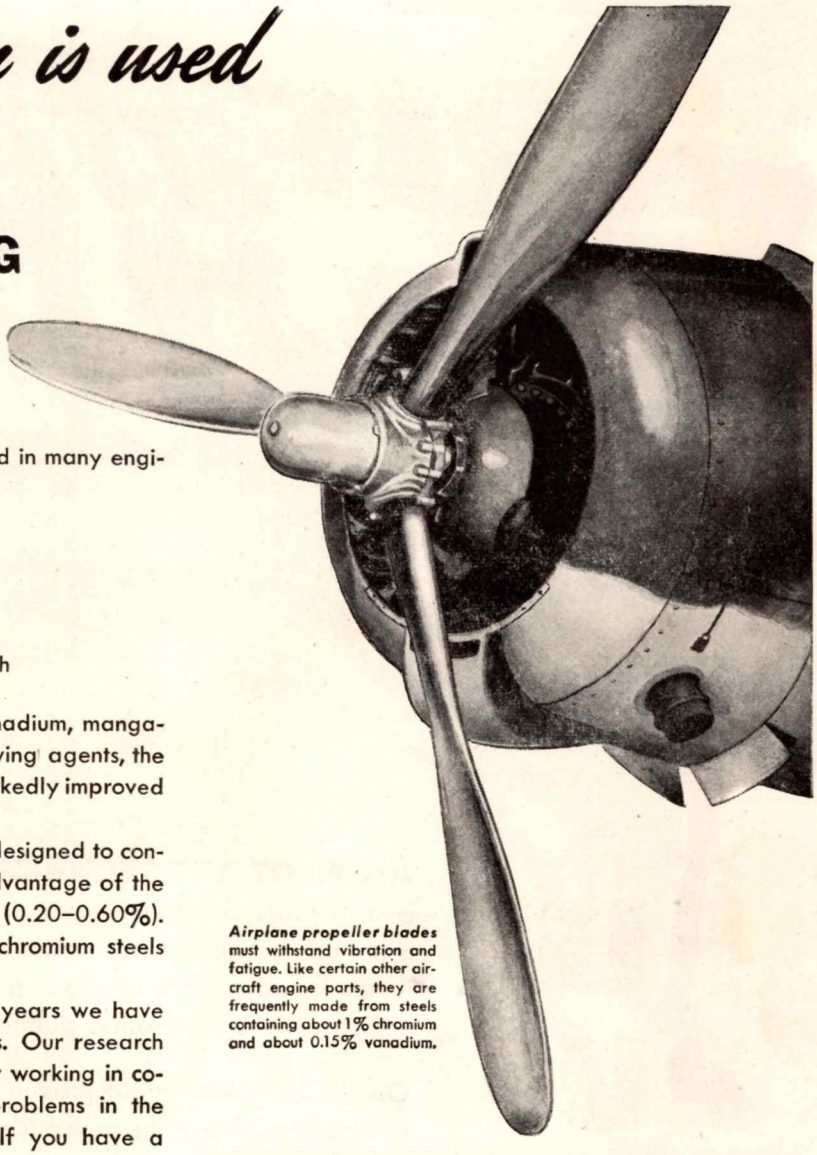

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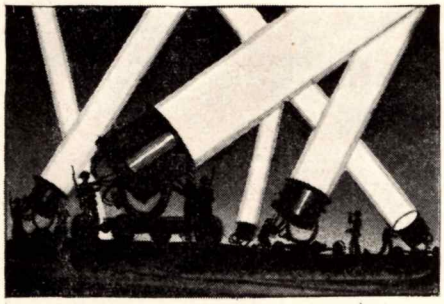
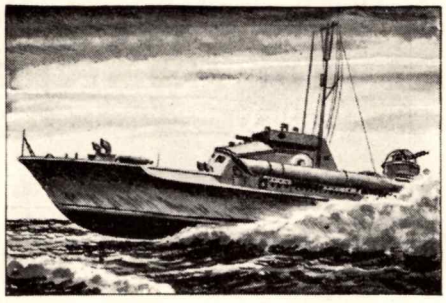


Ball Bearings for equipment that must move freely and quickly must resist abrasive wear, and keep true shape. Most precision ball bearings are made of 1.2-1.5% chromium steel with 0.2-0.5% manganese.



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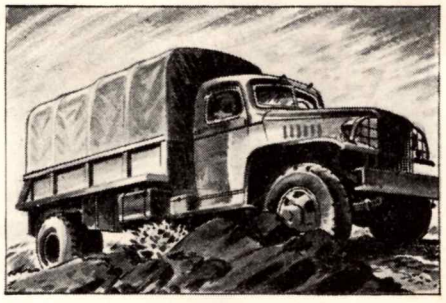

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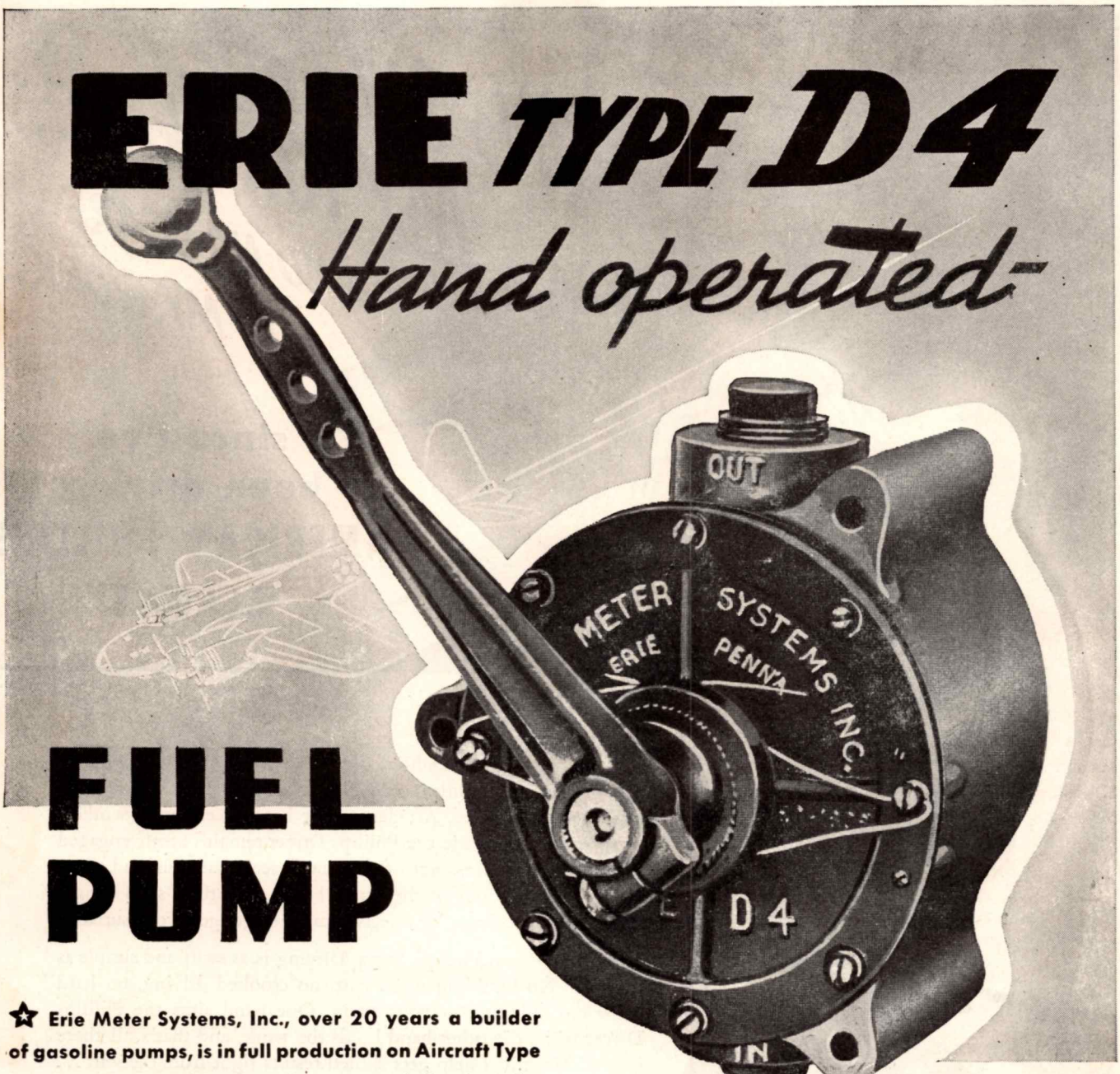

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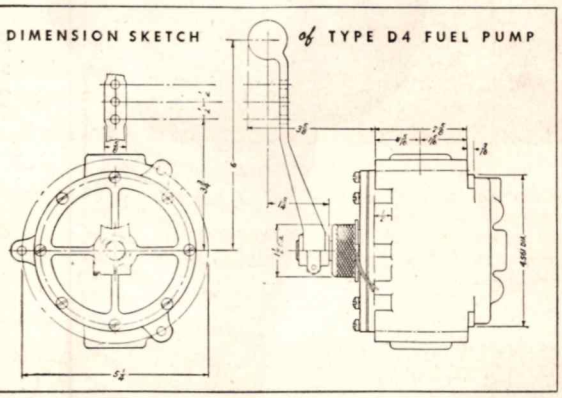

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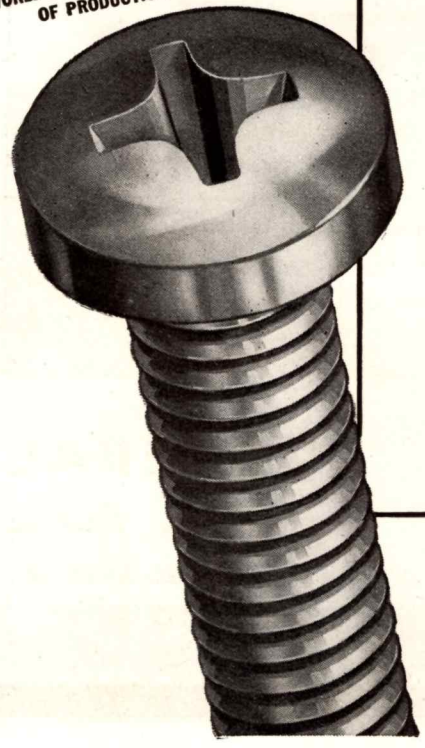

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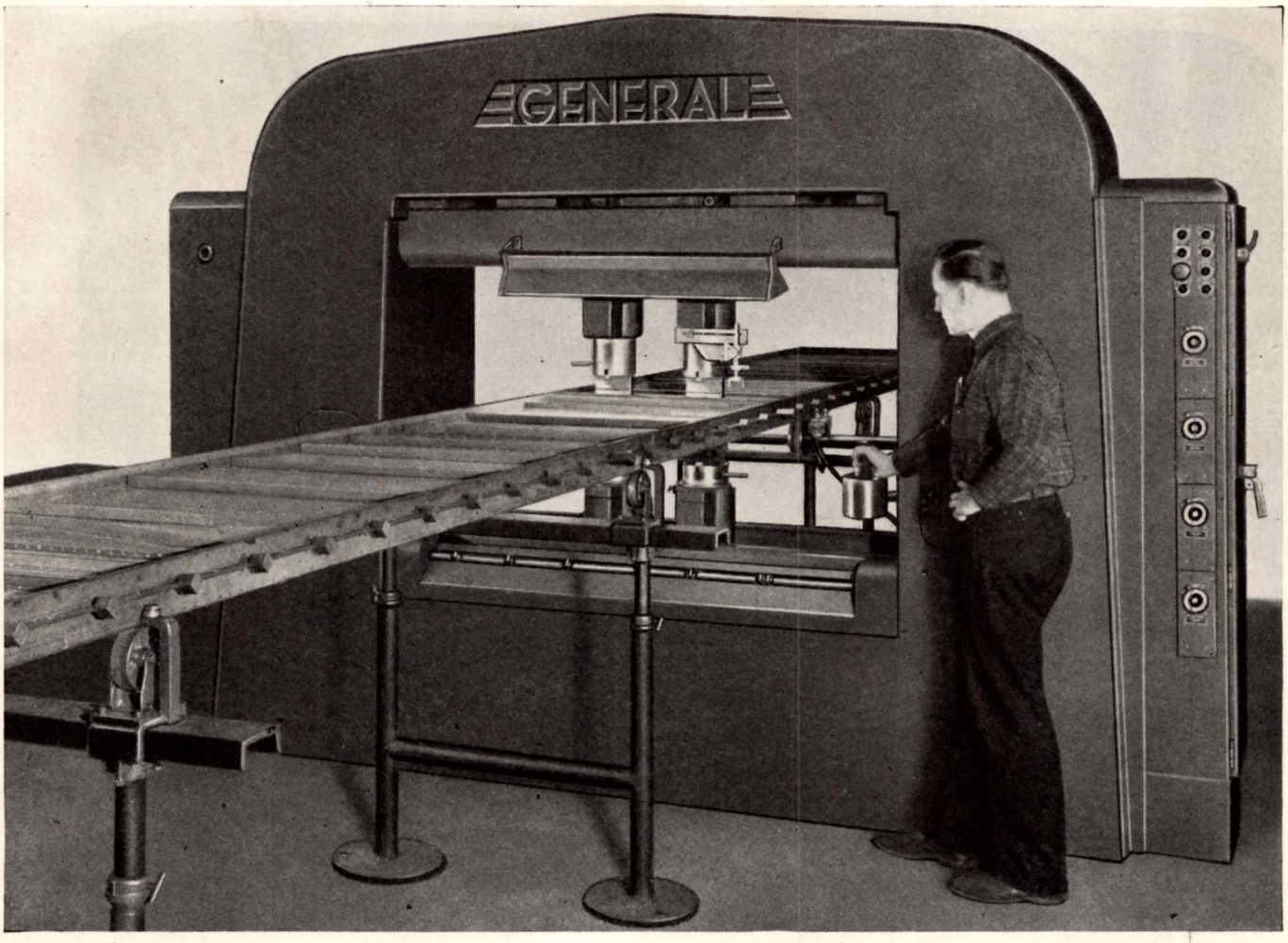

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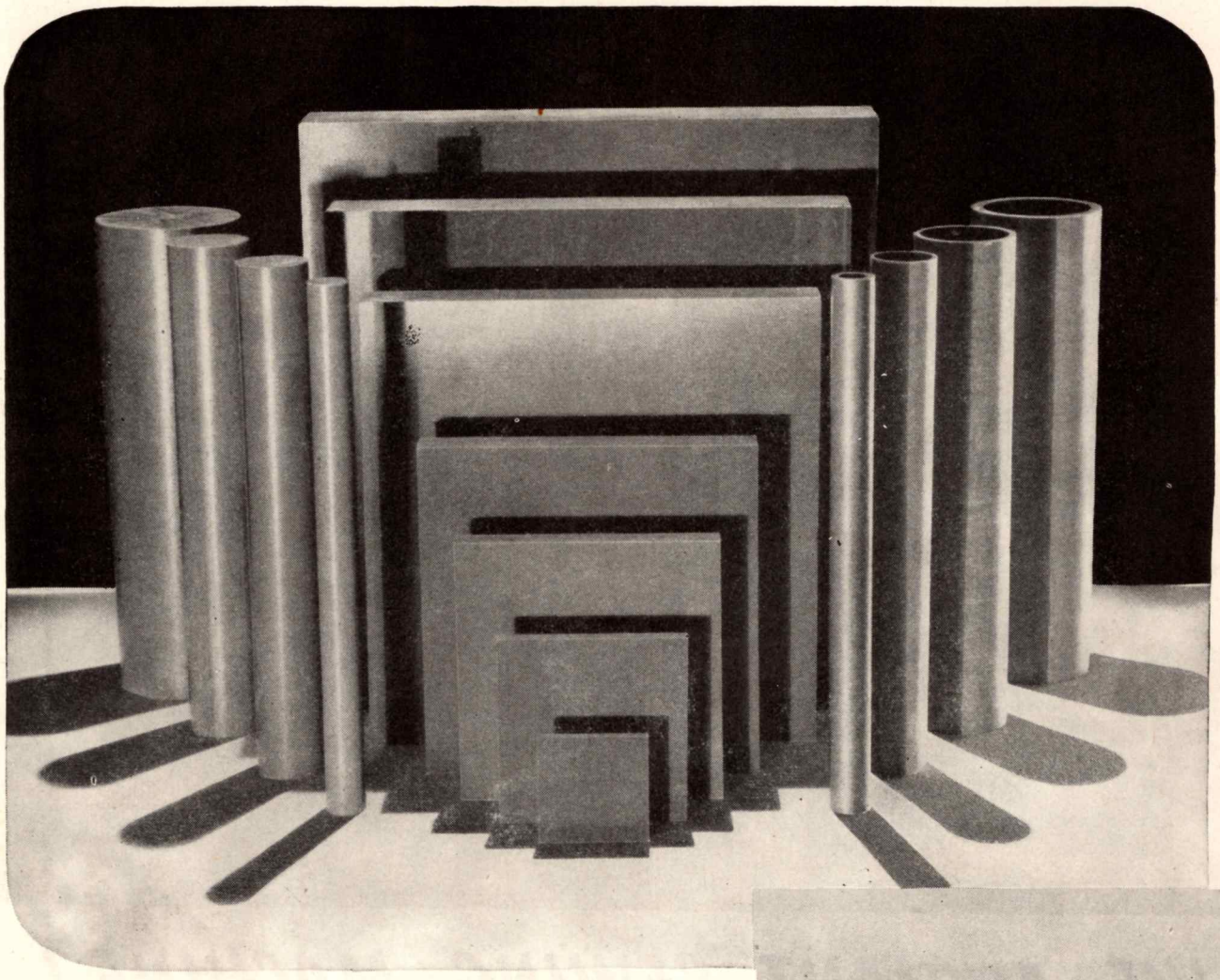


TEXTOLITE

G-E Textolite laminated sheets, rods, and tubes, are made in several grades that meet the construction requirements of our fighting aircraft. No other material besides plastics offers as diverse, useful, properties as these sheets, rods, and tubes.

G-E Plastics engineers will help you in applying laminated Textolite to your product. Write us for further information, Section R-5, One Plastics Avenue, Pittsfield, Mass.

BUY WAR BONDS

Listen to the news on the WORLD TODAY each week-day evening, CBS, 6:45 P.M. E.W.T. On Sunday, listen to the HOUR OF CHARM on NBC, 10:00 P.M. E.W.T.

PLASTICS DIVISIONS

GENERAL ELECTRIC

PD-115

SHEETS
RODS
TUBES

1. LIGHT WEIGHT
2. LOW MOISTURE ABSORPTION
3. EASY TO MACHINE
4. HIGH DIELECTRIC STRENGTH
5. CORROSIVE RESISTANCE
6. HIGH SPECIFIC TENSILE STRENGTH
7. HIGH SPECIFIC COMPRESSIVE STRENGTH
8. HIGH SPECIFIC FLEXURAL STRENGTH
9. HIGH SPECIFIC IMPACT STRENGTH
10. HIGH RESISTANCE TO WEAR

G-M

● The G-M Type 29 Relay is designed mechanically and magnetically to give unusual efficiency and dependability in operation. Its small size and light weight combined with rugged construction, characteristic of all G-M relays, make it ideal for a multitude of communications uses. The Type 29 is positive in action and requires an exceptionally low power input.

Numerous circuit combinations are available to meet practically any requirements. The high efficiency of the magnetic circuit insures high contact pressure. Phosphor bronze armature bearings, turning in accurately reamed holes in a brass bracket, insure free operation and long life. The contact springs and anti-vibration springs are of nickel silver. Mycalex insulators are available if specified. All steel parts are heavily cadmium plated and the coil is carefully impregnated so that the entire unit will withstand 200 hour 20% salt spray tests. The illustration above is actual size.

A free standardized sample of the Type 29 relay shown above, specification No. 12899* is available for examination and test to manufacturers who are prospective relay users. Orders for free samples must be accompanied by a priority of AA-4 or better.

*No. 12899 samples have 12 volt D-C coils, two double throw contacts and one single throw normally closed contact.

VISITRON PHOTOTUBES

are available in numerous sizes. Made by G-M, pioneer in development and manufacture of quality phototubes.

G-M LABORATORIES INC.

4318 NORTH KNOX AVENUE, CHICAGO 41, ILLINOIS

Buy WAR BONDS & STAMPS

THE BOYS WHO'VE been flying the bullet-like North American Mustang say it's one of the Army's hottest fighters.

Time and again, though heavily outnumbered by the enemy, they've turned in spectacular box scores.

Imagine, then, what these hell-for-leather American fighter pilots are going to do when they get an even *hotter* Mustang—an even *swifter* Mustang—a Mustang they can push upstairs into the thin high air *farther* and *faster* than they ever could before.

And that's exactly what they're going to get!

For this superb plane is now being powered by the Packard-built Rolls-Royce engine, with a new supercharged surprise: *British and Packard engineers have found a way to skyrocket the Mustang 2 miles higher than its effective fighting ceiling used to be!*

Two more miles of blue sky for Mustang pilots to fight in!

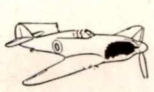
To make this possible, Packard has added engines for the Mustang to its mass-production output—another contribution to the finest fighting Air Force flyers in the world!

PACKARD *Precision-Built Power*

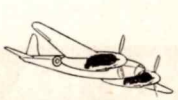
ASK THE MAN WHO OWNS ONE

MUSTANG
fighter

WARHAWK
fighter


HURRICANE
fighter

LANCASTER
bomber


MOSQUITO
fighter-bomber

NAVY
PT boats

LADISH

Quality
Drop Forgings

TO MARK PROGRESS

- Ladish facilities assure controlled quality forgings

ARMY E NAVY

LADISH DROP FORGE CO.

CUDAHY [MILWAUKEE SUBURB] WISCONSIN

Why did he make a Glue-spreader too?

ONE RELIABLE SOURCE FOR MOST TYPES OF ADHESIVES—VEGETABLE, CASEIN, AND RESINOUS

A NEW GLUE . . . the first in thirty centuries! When Frank G. Perkins, founder of this Company, discovered vegetable glue in 1906 he had taken the first step since ancient Egypt in making a better adhesive.

How could it be applied?

At that time there was no glue-room equipment for spreading vegetable glue. This discovery (which has saved industry over 40 million dollars) almost died aborning. But Perkins went to work and developed his own equipment.

More than that, he began a tradition which has been followed through to this day: *To have an exhaustive knowledge of how adhesives are applied, of the woods they go on, of the equipment used.* We still supply glue-room equipment, mixers, converters, spreaders and brushes, because just making a better adhesive is not enough—it must do a better job.

CHOOSE THE RIGHT TYPE

There are many kinds of adhesives and each one can do a particular job better than the next. It's important that you select the right type. Consider costs, waterproofness, and—above all—whether the adhesive can do the task laid out for it.

A slight mistake in specifications can cause the loss of thousands of dollars' worth of finished material. Are you concerned about the proper adhesive for your job? Have you the right reason for using or continuing to use Vegetable glue rather than Casein or Resin? Is the increased cost of resin or casein glue more than offset by the advantages that an improved water resistance would impart to your product? Is your's a question, not of water resistance, but of water-proofness? Or perhaps your problem is one of meeting a plywood specification.

To find the answers to such questions is merely to introduce the infinitely more involved problems of proper application of the adhesive to achieve good results. If the glue is to be resin what about catalysts, extenders, polymerization control? Will your job require liquid or powder form adhesive? Such questions confront you on each job requiring an adhesive.

LET US HELP YOU

Regardless of which of these four types of glue you use, questions of formula, mixing, working life, spread, assembly periods, pressure and setting time must be determined accurately.

We're anxious to help you.* It's our business to know the proper, least expensive adhesive for your job. Our research laboratory probably has the answer to whatever question you have about adhesives—if they don't, they'll get it.

Over a period of 35 years this company has developed a broad range of adhesives. Because of this we are biased to no particular type. We are prepared to recommend the most desirable for your specific job—or to formulate one that will do your job better.

PERKINS ADHESIVES HOLD · PERKINS ADHESIVES HOLD · PERKINS ADHESIVES HOLD · PERKINS ADHESIVES HOLD

***Use PERKINS BONDING SERVICE**

You may use Perkins Bonding Service in three ways: (1) Write for detailed data sheets on any of the Perkins Resin Glues. (2) Call in a Perkins Technician for individual consultation, or (3) Write for booklet that describes all Perkins Resin Glues and also describes Mixing and Spreading Equipment.

Act on at least one of these now. Obviously, no obligation. Perkins Glue Company, 601 Cannon Avenue, Lansdale (near Philadelphia), Pennsylvania. In Canada, Perkins Glue Company of Canada, Ltd. Kitchener, Ontario.

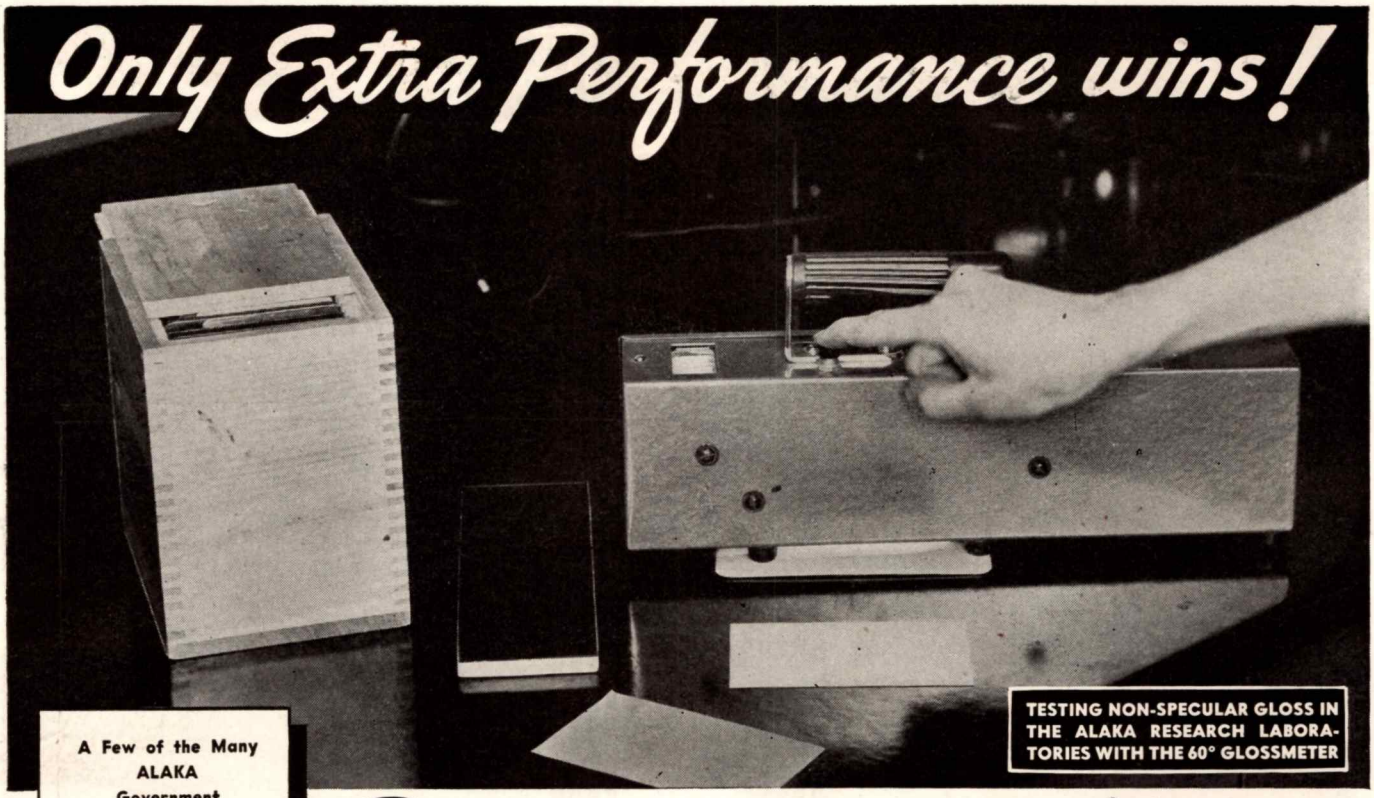
Warehouses in JAMESTOWN • GRAND RAPIDS • SAN FRANCISCO • LOS ANGELES • CHICAGO • ST. LOUIS • GREENSBORO • TACOMA • PORTLAND

Although its every resource was built upon peacetime products of safety and comfort, E. A. Laboratories is today devoting its facilities exclusively to weapons of war. Here is clear evidence of the eagerness with which E. A. employes, along with all loyal Americans, accept the challenge to our freedom which must be preserved for generations to come. The glorious sacrifices which our forefathers made in order to give LIBERTY and freedom of action to the people of the United States of America shall be our inspiration.

E. A. LABORATORIES, INC., BROOKLYN 5, N. Y.

MAKERS OF AIRCRAFT, AUTOMOTIVE AND MARINE APPLIANCES

Only Extra Performance wins!



TESTING NON-SPECULAR GLOSS IN THE ALAKA RESEARCH LABORATORIES WITH THE 60° GLOSSMETER

A Few of the Many ALAKA Government Specification Finishes with Non-Specular Gloss as a Major Consideration

•

U. S. ARMY AIR CORPS
14105-B
Lacquer
Cellulose Nitrate
Camouflage

•

U. S. ARMY AIR CORPS
14106-A
Dope
Pigmented Nitrate
Camouflage

•

U. S. NAVY
AERONAUTICAL
M-485 c
Lacquer
Non-Specular

•

U. S. NAVY
AERONAUTICAL
M-498
Dope
Cellulose Nitrate
Pigmented, Non-Specular

Does your lacquer hold ITS SPECIFIED NON-SPECULAR GLOSS?

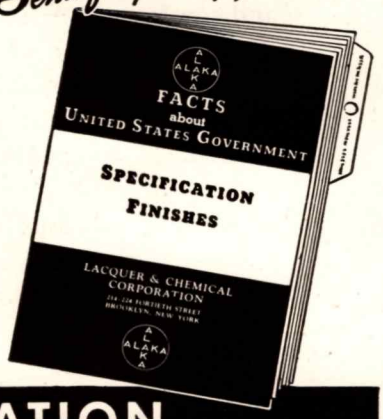
The Army and Navy are making our enemies know that our planes "are there"... without being seen. Visibility, in terms of gloss or reflection is vitally important.

In their specifications for aircraft finishes, they definitely indicate the permissible degree of gloss, with a small measure of tolerance.

They require that the finish on a plane in Sicily, Italy, New Guinea, the Aleutians or over the Ruhr, has the same degree of non-specular gloss, as it had when it was made, tested and approved. They expect, require and in fact, demand, that the finish holds its specified non-specular gloss regardless of the time which elapses between manufacture and actual service.

- New, Complete
- up to the minute
- Catalogue of
- U. S. Government
- Specification Finishes

Send for your copy



ALAKA HOLDS ITS NON-SPECULAR GLOSS. Here's the Proof:

Aircraft Lacquers	
SPECIFICATION LIMITS	0.1 to 0.3 per mil
ALAKA Lacquers	
When Manufactured	0.1 per mil
After 3 months	0.1 per mil
After 6 months	0.1 per mil

ALAKA *Extra Performance*

This Extra Performance can help you. May we show you how?

LACQUER & CHEMICAL CORPORATION

214-224 FORTIETH STREET · BROOKLYN 32, N. Y.

ANOTHER ARO *First!*

1 RUGGED PLASTIC BODY AND HANDLE

2 MOTOR OF FINEST ALLOY STEELS

3 FULL BALL BEARING CONSTRUCTION

4 1 LB. 12 OZ. WEIGHT

5 6¼" OVERALL LENGTH

6 2500 RPM

7 ⅛", 3/16", ¼" OR 5/16" JACOBS CHUCK

THE NEW ARO PNEUMATIC DRILL WITH *Plastic* CASE

Again ARO Engineering Leadership scores an important "first"—bringing you this new Model 101 ARO Pneumatic Drill with *all-plastic housing and handle!* It's today's lightest-weight portable pneumatic drill—yet it packs power-to-spare and durability for toughest small tool production jobs. Its lightness makes it ideal for women workers. Trigger touch controls speed.

Proved in exhaustive tests in our laboratories and in numerous production lines... this new ARO Pneumatic Drill meets industry's need for *greater speed* and *less fatigue* in round-the-clock production. Investigate ARO!

THE ARO EQUIPMENT CORPORATION
BRYAN, OHIO

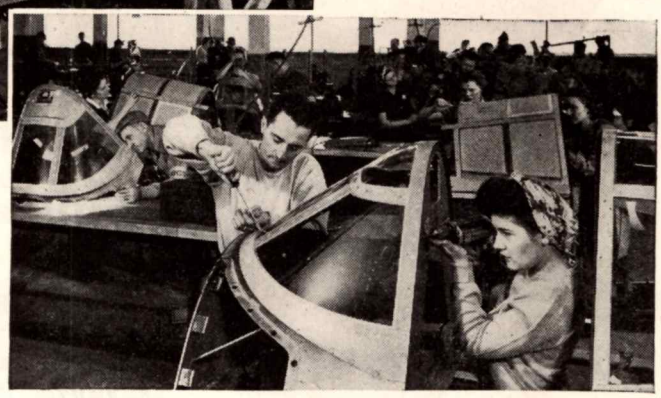
ARMY E NAVY

THE ARO EQUIP. CORP. PNEUMATIC ARO TOOLS BRYAN, OHIO

Another **L·O·F** *Wartime Contribution...*

CANOPIES FOR AIRCRAFT!

In two of Libbey·Owens·Ford's plants, large-scale production is concentrated on assembly of canopies for fighting craft. At the right, installing Bullet-Resisting Glass windshield.



Much of Libbey·Owens·Ford Production is Devoted to Clearer Vision and Safer Aircraft Glass

★ Libbey·Owens·Ford's production of wartime materials is illustrated by the above scenes showing assembly of aircraft enclosures. In the larger, the assembly of a canopy, or "greenhouse", for a well-known fighting plane is nearing completion. The windshield shown in the smaller photograph contains Bullet-Resisting Glass, a product of L·O·F Research for better vision and greater protection.

It is this capacity for highly specialized production by thoroughly skilled workers, plus the vast store of knowledge obtained from over a quarter of a century's experience in making glass for thousands of uses, that has enabled Libbey·Owens·Ford to make important contributions in the manufacture of military aircraft.

There are many other developments that have come from the engineering laboratories of Libbey·Owens·Ford for both wartime and peacetime use. We welcome the opportunity to co-operate with aircraft and allied manufacturers in supplying technical assistance. Libbey·Owens·Ford Glass Company, 7193 Nicholas Building, Toledo 3, Ohio.

L O F **LIBBEY·OWENS·FORD**

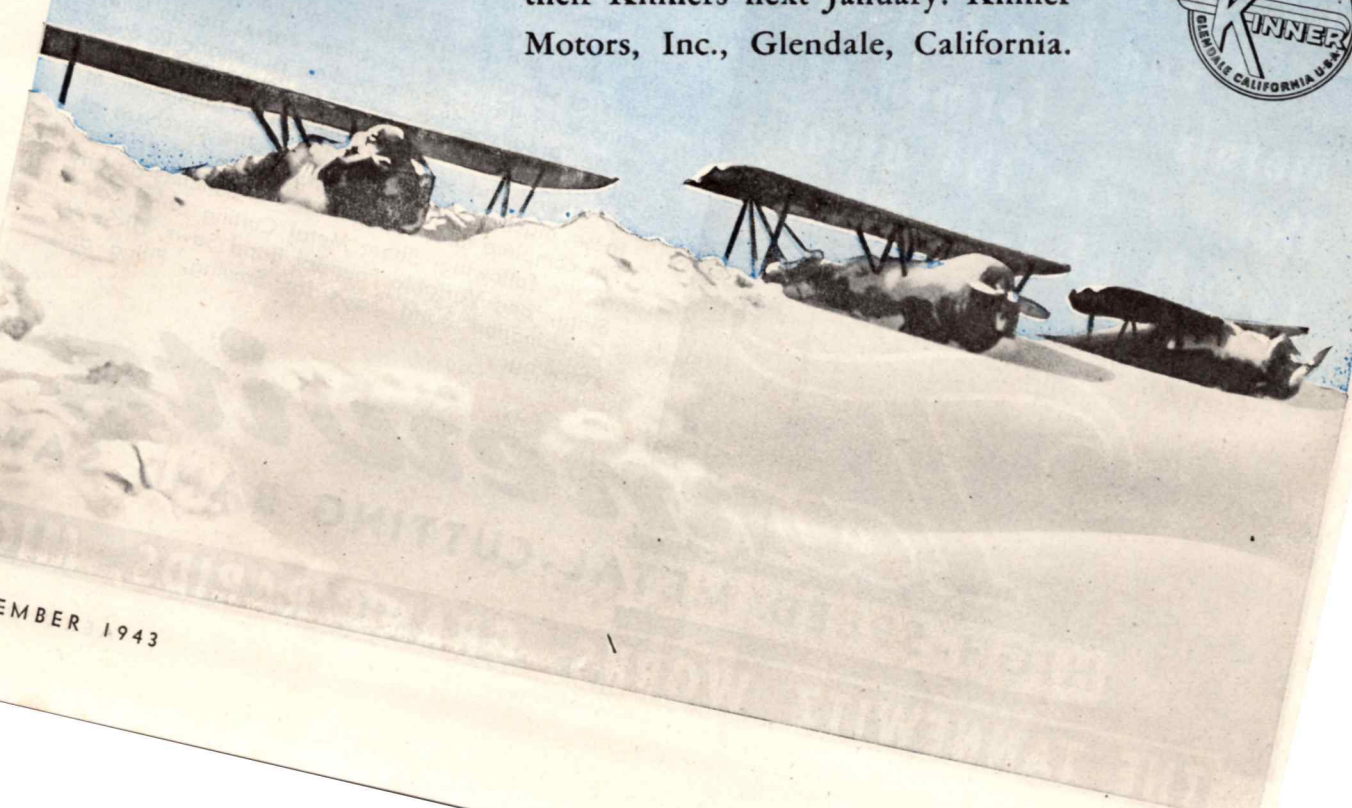
A GREAT NAME IN *Glass*

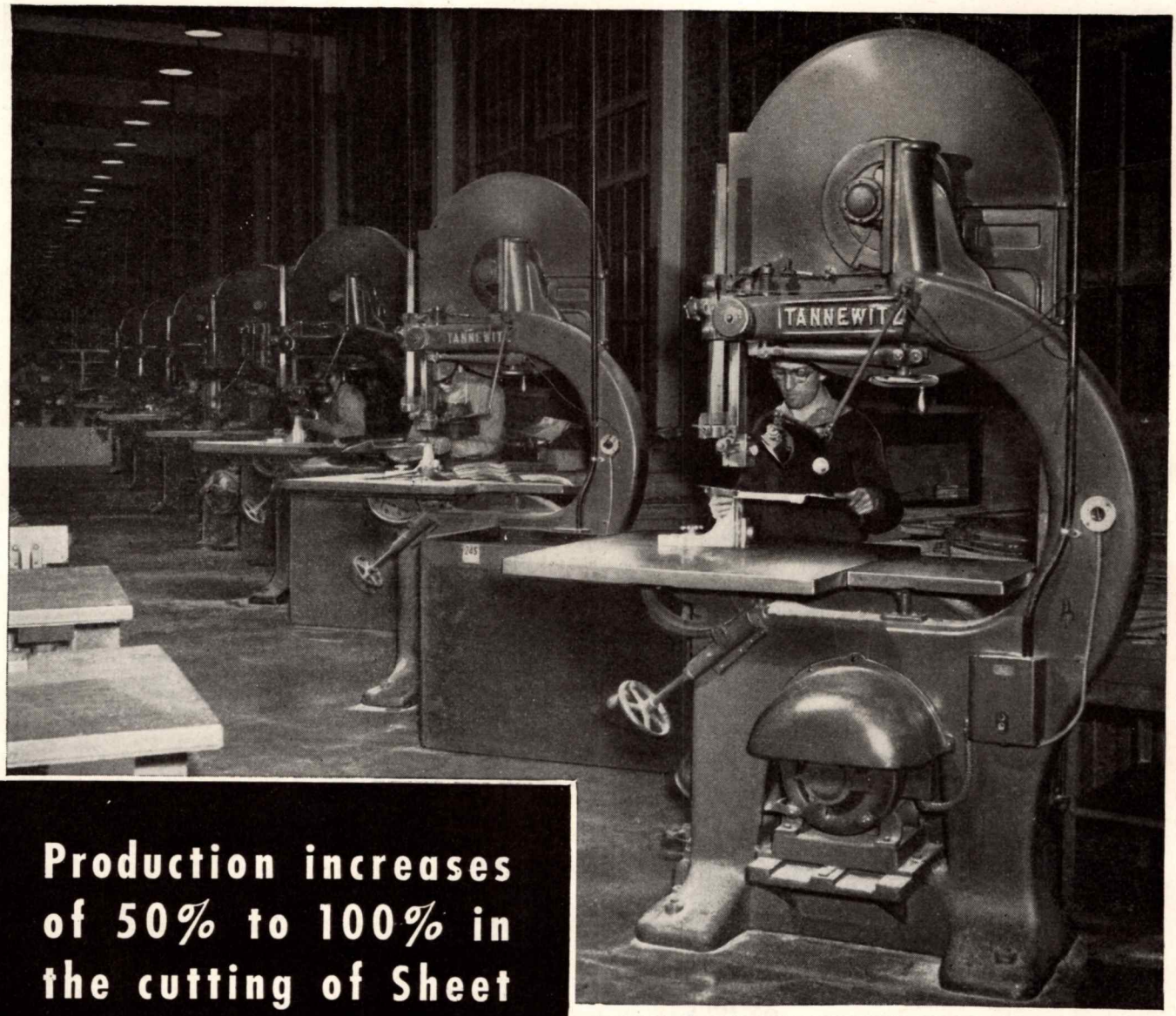
LESSON FOR AUGUST

Out on the Arizona desert where the thermometer is boiling up around 120° this summer, hundreds of Kinner engines are earning a new record for dependability in their daily primary training grind. And when another sub-zero winter blows over Canada this fall, other Kinners will help to keep the British training program going, too.

Few owners can ever subject their engines to such sustained torture. But it is satisfying for Kinner owners to know that in August they won't have to worry about their Kinners next January. Kinner Motors, Inc., Glendale, California.

KINNER MOTORS INC. GLENDALE CALIFORNIA U.S.A. KINNER





BATTERY OF TANNEWITZ HIGH-SPEED BAND SAWS AT THE GLEN L. MARTIN BALTIMORE PLANT

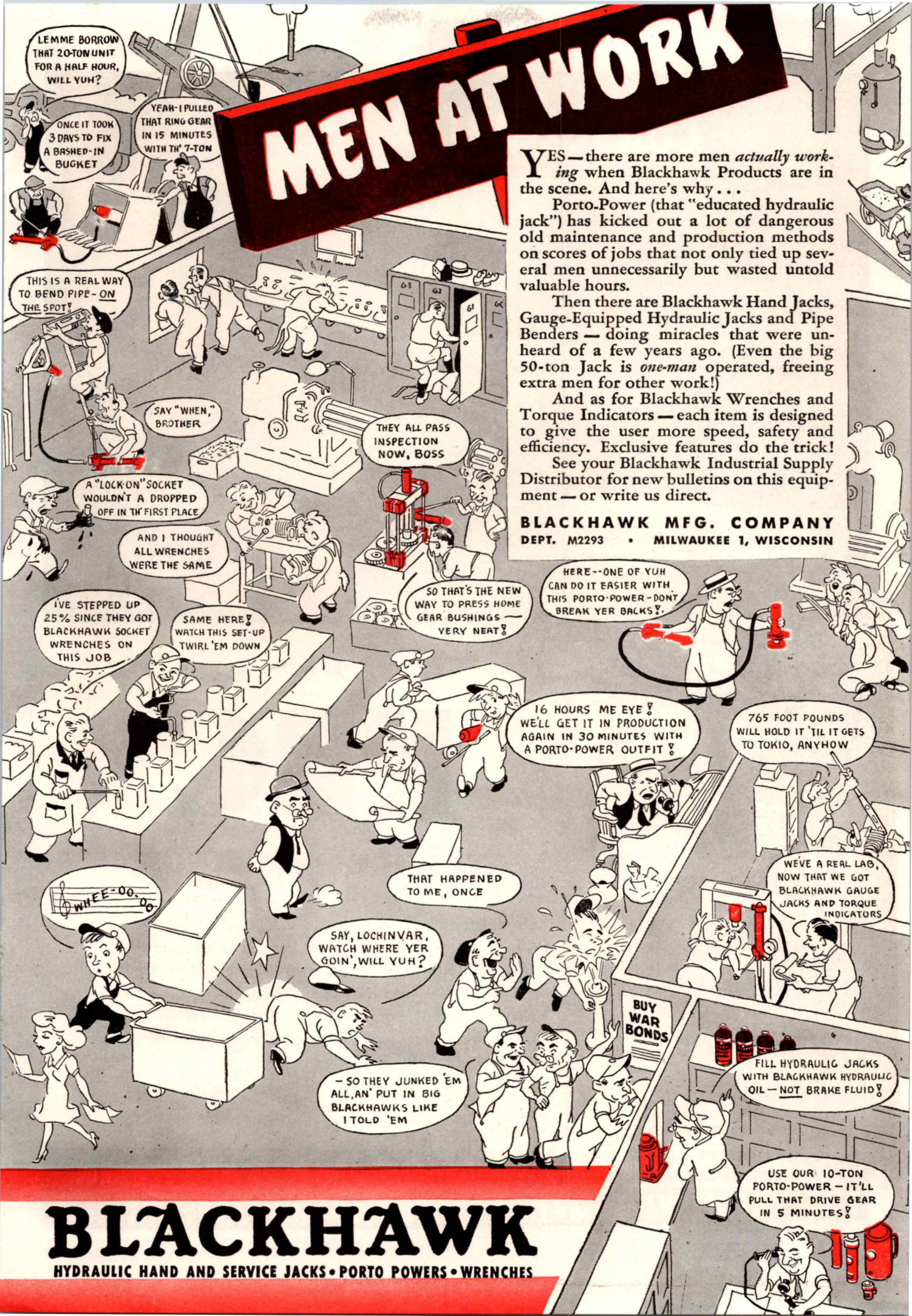
Production increases of 50% to 100% in the cutting of Sheet Steel and Non-ferrous Metals • • formed or flat • • are the usual result of installing

The tremendous success of these machines in leading plants throughout the country is due to the fact that they are precision-built to deliver over two miles of vibrationless saw-blade travel per minute, equipped with hydraulic brakes, automatic in case of saw breakage, "Speedi-Change" tires and many other patented features which can be duplicated in no other band saws. You'll find the purchase of these machines an exceedingly good investment. For complete information write for bulletins on any of the following: Sheet Metal Cutting Band Saws, Single and Variable Foundry Band Saws, Di-Saws, Combination Band Saws for Sawing, Filing and Polishing.

Tannewitz

HIGH-SPEED METAL-CUTTING BAND SAWS

THE TANNEWITZ WORKS, GRAND RAPIDS, MICH.



YES — there are more men *actually working* when Blackhawk Products are in the scene. And here's why . . .

Porto-Power (that "educated hydraulic jack") has kicked out a lot of dangerous old maintenance and production methods on scores of jobs that not only tied up several men unnecessarily but wasted untold valuable hours.

Then there are Blackhawk Hand Jacks, Gauge-Equipped Hydraulic Jacks and Pipe Benders — doing miracles that were unheard of a few years ago. (Even the big 50-ton Jack is *one-man* operated, freeing extra men for other work!)

And as for Blackhawk Wrenches and Torque Indicators — each item is designed to give the user more speed, safety and efficiency. Exclusive features do the trick!

See your Blackhawk Industrial Supply Distributor for new bulletins on this equipment — or write us direct.

BLACKHAWK MFG. COMPANY
DEPT. M2293 • MILWAUKEE 1, WISCONSIN

BLACKHAWK

HYDRAULIC HAND AND SERVICE JACKS • PORTO POWERS • WRENCHES

CAIRO, June 28 (AP).—U. S. Ninth Air Force Liberators shattered Axis hangars, pitted runways and started fires at two airdromes near Athens yesterday in a powerful followup to the Thursday raid at Salonika which opened the trans-Mediterranean aerial offensive against German and Italian holdings in the Balkans, it was announced today.

High explosives were loosed ef-

"South Pacific: (All dates are east longitude)

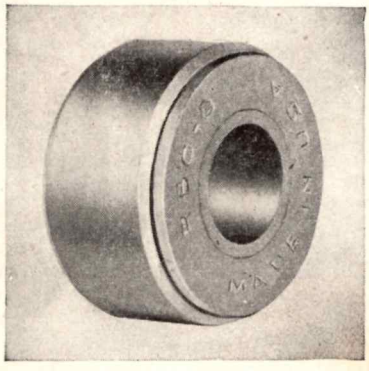
"1. On the evening of July 5, army Liberator (Consolidated B-24) heavy bombers attacked Japanese installations on Ballale Island, Shortland Island area. Five fires were started. About 12 Zero fighters attempted to intercept but were driven off. No U. S. losses were sustained.

"2. On July 6, in the early

uses

RBC

NEEDLE BEARINGS



'Round the clock these heavy 4 motored Liberators are "block-busting" enemy installations from one end of the earth to the other. And 'round the clock we are turning out RBC Aircraft Needle Bearings for use in the wing flaps and landing gear of these B-24's — and for many other types of military and naval planes — bombers, fighters and transports.

ROLLER BEARING CO. of AMERICA

TRENTON . . . . NEW JERSEY

There's No Blueprinting Seating Comfort

IN your mind's eye, you know exactly what your next plane will look like long before the mock-up. You can check its aerodynamics in the wind tunnel, prove its performance by flight test. At every step you can blueprint your progress.

But unfortunately there's no blueprint for passengers —no test to predetermine exactly what they'll be like. Long and short, fat and lean, male and female, they crowd the loading ramp with only one thing in common: their demand for comfort—that intangible sense of ease and well-being that beggars blueprinting!

Behind Chase Flight Fabrics lies 75 years of experience in helping all types of people to travel comfortably. Today, for leading domestic and global airlines, Chase is developing new Flight Fabrics with minimum weight and pleasing, easy-to-maintain textures . . . fabrics that combine deep-cushioned ease with restful posture-control.

Our designers are ready to help you put maximum passenger-comfort into your "plane of tomorrow."

Chase Flight Fabrics

L. C. CHASE and COMPANY • 295 Fifth Avenue, New York City

Sales Division of Sanford Mills • Offices: Boston, Detroit, Chicago, Los Angeles

"Will you teach me to fly when you come back?"

Flying is no marvel to the youth of today.

They take it for granted.

Like the flight of birds.

Like radio, or electrical refrigeration, or countless other modern wonders.

More marvels, even now, are on the way.

They will pour from laboratories and factories — after Victory!

All Sparton plants, of course, are deep in war work now.

We are building horns, sirens and warning signals of every type, for motor cars, tanks, trucks, jeeps, planes and ships.

Highly technical equipment, too, for the Radio Division of the Signal Corps.

But Sparton's *life work* is building for a busy peacetime world.

We'll be back at that, after the war.

With new surprises in horns, in radio and other products for the automotive, marine and aviation fields.

Plan ahead with Sparton, for a better, happier World of Tomorrow.

PLAN AHEAD WITH SPARTON! *We invite correspondence with others who are interested in post-war marketing opportunities, in which our 43-year experience in electrical precision manufacture can be invaluable.*

SPARTON

PRECISION ELECTRICAL MANUFACTURERS SINCE 1900

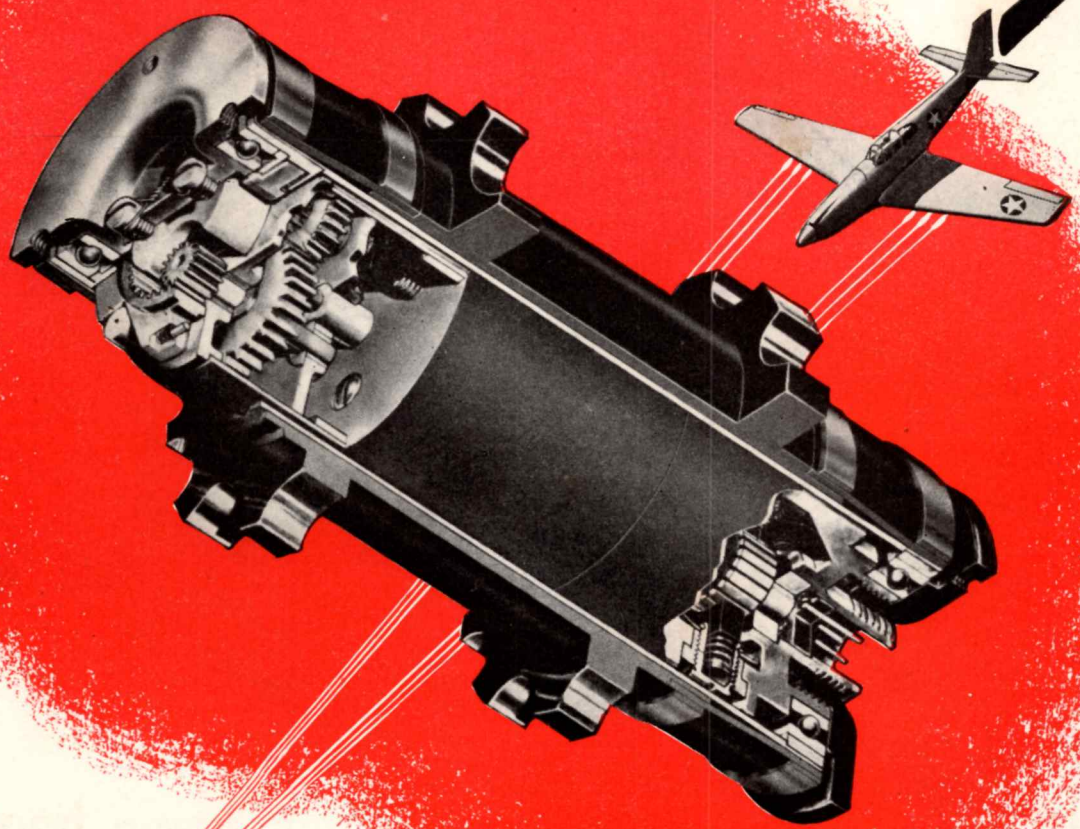
Sparton is proud of its continued association — through peace and war — with important manufacturers, a few of whose insignia are shown below.

CURTISS-WRIGHT
Ford
BOEING
DOUGLAS
INTERNATIONAL HARVESTER COMPANY
White
Bendix
BREWSTER
AUTOCAR
PACKARD
Lockheed
Vultee
CONSOLIDATED
AIRCRAFT

THE SPARKS-WITHINGTON COMPANY • JACKSON, MICH.

SPARTON OF CANADA, LIMITED, LONDON, ONTARIO

Announcing



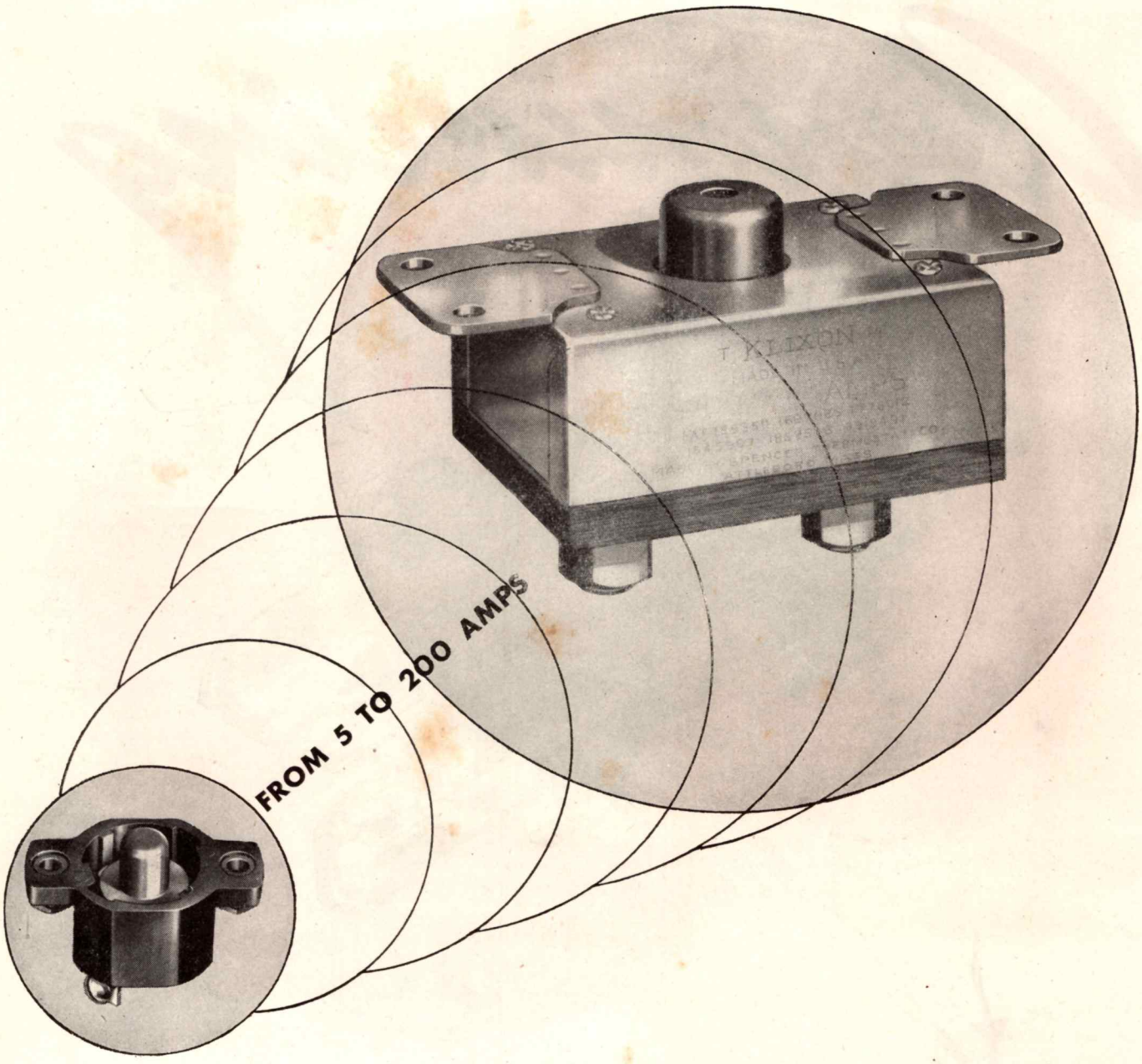
THE NEW HARVILL *Light Weight* 50-CALIBRE AMMUNITION BOOSTER

For use in any craft with electrical facilities, this booster assures positive action under adverse conditions. Produced and sold by Harvill Development Co., an affiliate of the H. L. Harvill Mfg. Co. with pioneer experience in aviation products ...your assurance of precision design and workmanship . . . of *delivery on schedule.*

Literature available to qualified parties.

H. L. HARVILL DEVELOPMENT CO.

POST OFFICE BOX 335 • VERNON, CALIFORNIA



KLIXON CIRCUIT BREAKERS

All planes can have the advantages of Klixon Circuit Breakers throughout. For these breakers are available in sizes, ranging in close convenient steps, from 5 to 200 amps.

And what are their advantages?

First of all, they give you positive, snap-acting protection from harmful overloads or short circuits . . . not forgetting the fact that once harmful conditions are corrected, the circuit is reestablished by merely pushing the breaker's push button or switch located on the panel board.

Next, and just as important, they are not affected by harmless transient shorts. They eliminate nuisance breaks.

Also, important, these breakers are disc operated. They contain no fussy or complicated parts . . . and are therefore more compact *and lighter in weight.*

Send for bulletins containing performance charts, sizes and weights of Klixon Aircraft Circuit Breakers. Specify your requirements.

ARMY E NAVY

KLIXON

TRADE MARK REG. U.S. PAT. OFF.

Spencer Thermostat Co.

Attleboro, Mass.

CLEAR OBJECTIVE

Rain or Shine

Marquette

All-Weather Windshield Wiper

● 'Round the clock, the bombing of our enemies must continue. In rain and sleet, the Marquette Windshield Wiper provides clear sight for pilot and bombardier, an important factor in the fight to Victory!

The Marquette

METAL PRODUCTS COMPANY

Cleveland • • • • Ohio

TAKE THE LOAD OFF

THE ENDS OF GEAR TEETH

"End bearing," a concentration of stress on one end of gear teeth, always seriously limits the useful life of the gear and impairs its operation while in service.

You can eliminate end bearing troubles by shaving gear teeth to the ELLIPTOID form. This produces a tooth thicker in the central section than at the ends. The difference in T.T. is usually .0003" to .0005" per inch of face width on each side of the tooth. The amount of crown can be varied to compensate for errors encountered in assembly and because of heat treat distortion. And it takes no more work, no more machine time or cost to produce the ELLIPTOID tooth form than it does the conventional tooth.

If the gear is to be lapped as a final operation, the ELLIPTOID form materially reduces lapping time. In fact, the lapping time on an ELLIPTOID tooth gear is only about one-third that of a comparable gear with conventional tooth form.

Send for *descriptive bulletin on RED RING Gear Shaving and the ELLIPTOID Tooth Form.*

NATIONAL BROACH AND MACHINE CO.

RED RING PRODUCTS

5600 ST. JEAN · DETROIT, MICH.

SPECIALISTS ON SPUR AND HELICAL INVOLUTE GEAR PRACTICE

ORIGINATORS OF ROTARY SHAVING AND ELLIPTOID TOOTH FORMS

IT TAKES 100 MEN TO LIFT THIS BATON

THE CONDUCTOR waves a little stick and, like magic, entrancing music cascades through the concert hall. With superb artistry, he brings out every nuance of the symphony, from light lilting run to crashing crescendo. The world calls him a master.

But even the genius of a symphony conductor could not make a baton audible. The music that enraptures the audience flows from the hearts and talents of the orchestra.

In the industrial world, too, there are some who must do the less spectacular jobs. The Joyce Machine Company is an example. Parts, sub-assemblies and machines built by Joyce are playing a major role in scores of great war plants throughout the country, solving difficult production problems, achieving new standards of speed and efficiency, helping to draw nearer the day of Victory.

From the Joyce plant, too, flows production quantities of sub-assemblies for gun mounts and other vital precision parts for implements of war, fabricated and assembled by Joyce craftsmen. The highly developed skills and experience of Joyce engineers and craftsmen are being utilized by the Army, Navy, Maritime and Aircraft services—as well as by the nation's largest industrial organizations. This same skill and experience can be helpful to you—in meeting present war contracts—in solving postwar production problems. A Joyce representative will be glad to explain in detail the unique advantages we can offer.

BEHIND THE MAN ▸ BEHIND THE MAN ▸ BEHIND THE GUN

JOYCE
Machine Company
2000 WHEATSHEAF LANE • PHILADELPHIA
★
MANUFACTURERS OF PRECISION PARTS
FOR ALL KEY INDUSTRIES

FOUR BIG REASONS WHY YOU SHOULD BUY HALLOWELL WORK-BENCHES

1 You get what you want! Over 1367 "Hallowell" ready-made interchangeable bench combinations to fit practically any need.

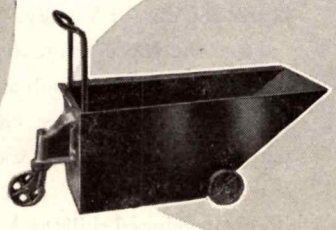
2 You know what the cost will be! Unlike when building your own benches, there's no hit-or-miss estimating of cost.

3 You can get them quickly! Because deliveries of "Hallowell" Equipment are better than average.

4 They are a good investment! Well built for long usage. Constructed for easy movability.

• *Write for "Hallowell" Catalog Today* •

Fig. 928. "Hallowell" Work-Bench with laminated wood top. Drawer is extra. Pat'd and Pats. Pend.



"HALLOWELL" TOTE BOX TRUCKS

Displace aged, time worn method of transporting oil turnings to "Whizzer." Save almost 100% of cutting oil formerly wasted and being especially designed for the job also save labor and time.

STANDARD PRESSED STEEL CO.

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After V-day . . . many of electronics' wonders will be serving on our airways . . . making navigation surer . . . flight safer . . . travel more convenient. And because so many of these developments will depend on perfect signal reception, ignition shielding will play an increasingly important role.

That's why *continuing research* and *development* is a *major* program at TITEFLEX. Already it has contributed many outstanding shielding developments such as the *Unimold lead . . . developments aimed to make ignition shielding electrically leak-proof . . . mechanically fool-proof.

Today, this intensive TITEFLEX research and development on ignition shielding is focused on providing increased safety for our battleships of the air. But for tomorrow, it promises new standards of performance for our great transports flying the peaceways of the world. Titeflex Metal Hose Co., 511 Frelinghuysen Avenue, Newark 5, N. J.

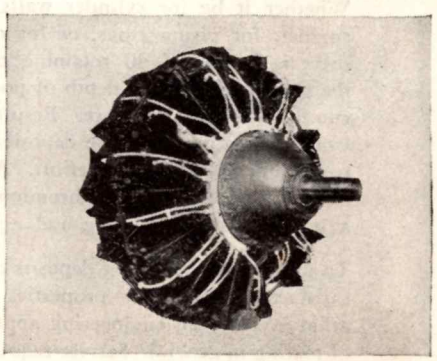
*Reg. U. S. Patent No. 2,123,162

ARMY E NAVY

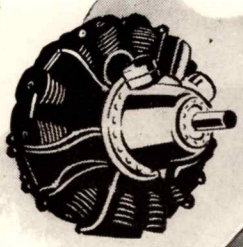
Titeflex

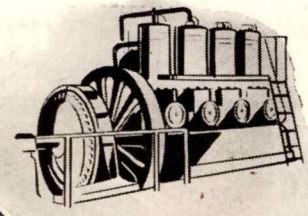
REG U S PAT OFF.

RADIO SHIELDED IGNITION HARNESSES

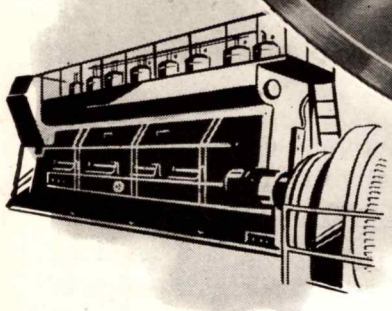


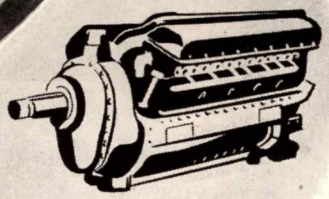
RADIO, POWER, AND IGNITION SHIELDING — HIGH PRESSURE FUEL, OIL, AND AIR LINES — CONDUIT, FITTINGS, COMPLETE ASSEMBLIES





There is
a special type of
OIL RETAINING CHROMIUM PLATE
best suited for each application





UNITED CHROMIUM LICENSEES ARE IN PRODUCTION on different types of oil retaining deposits of chromium for different needs

Whether it be for cylinder walls of Diesel or Aircraft engines, for piston rings, or for other wearing surfaces, there is a type of oil retaining chromium plate having the proper degree and depth of porosity which is a short-cut to better performance. Results now being obtained from applications of these deposits are making important contributions to the war effort. And United Chromium, having pioneered in the chromium plating industry, has a leading part in guiding and expanding these uses.

To produce oil retaining deposits of chromium plate with satisfactory lubricating properties and long life in operation involves an engineering approach and a knowledge of plating in general. Service requirements, base materials, cleaning cycles, coordination and control of operating conditions are just a few of the factors that must be considered if best results are to be obtained. United Chromium makes available to its licensees the results of extensive research and development work carried on over a period of many years both in the laboratory and in the field.

Already, large quantities of cylinders, piston rings and other parts of internal combustion engines have been processed by our licensees to meet the severest operating conditions . . . already, far-sighted engine manufacturers are planning big things for oil retaining deposits of chromium in their post-war designs.

Any inquiry to any office below will receive prompt attention.

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INCORPORATED

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P. O. Box No. 1229, Waterbury, Conn.

There's a *Weber Representative** on all These Major Planes

*Floor board assemblies, compartment doors, navigator tables, bomb bay, nose wheel and gunner's access doors, rifle racks, radio table, bombardier seats, plywood wings and control surfaces, hydraulic press stampings, etc.

AIRCRAFT DIVISION

ALL OVER THE WORLD today men are working and fighting to win this war... working at home and fighting on the many battlefronts. High on the list of things essential to victory for any army is the airplane... fighter, bomber, cargo and transport. Fortunately for us and for all the Allied Nations, we have these planes... good ones... and lots of them. And America is making more of them each day than any nation on earth.

We are proud to say that there is a Weber representative* flying on every plane pictured here and in many of America's fighting ships.

Our Aircraft Division is organized to meet the varied production requirements of the respective manufacturers. It is completely equipped both with facilities and experience for solving your special manufacturing problem in metal, wood or glass. Write or wire today for the specific information that interests you.

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WEBER

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Republic Aviation Thunderbolt

...when a *Thunderbolt* lands

Considered the fastest and most powerful high-altitude fighter in the sky today, the Republic P-47 Thunderbolt relies upon time-tested Houdaille hydraulic mechanism to raise or lower its rugged landing gear and to operate its wing flaps.

Behind Houdaille products is more than a quarter-century of engineering experience which today is producing equipment *in quantity* for many types of war planes, from the highest speed fighters to the heaviest bombers.

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MUSKEGON MOTOR SPECIALTIES CO.
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SKINNER COMPANY, Ltd.
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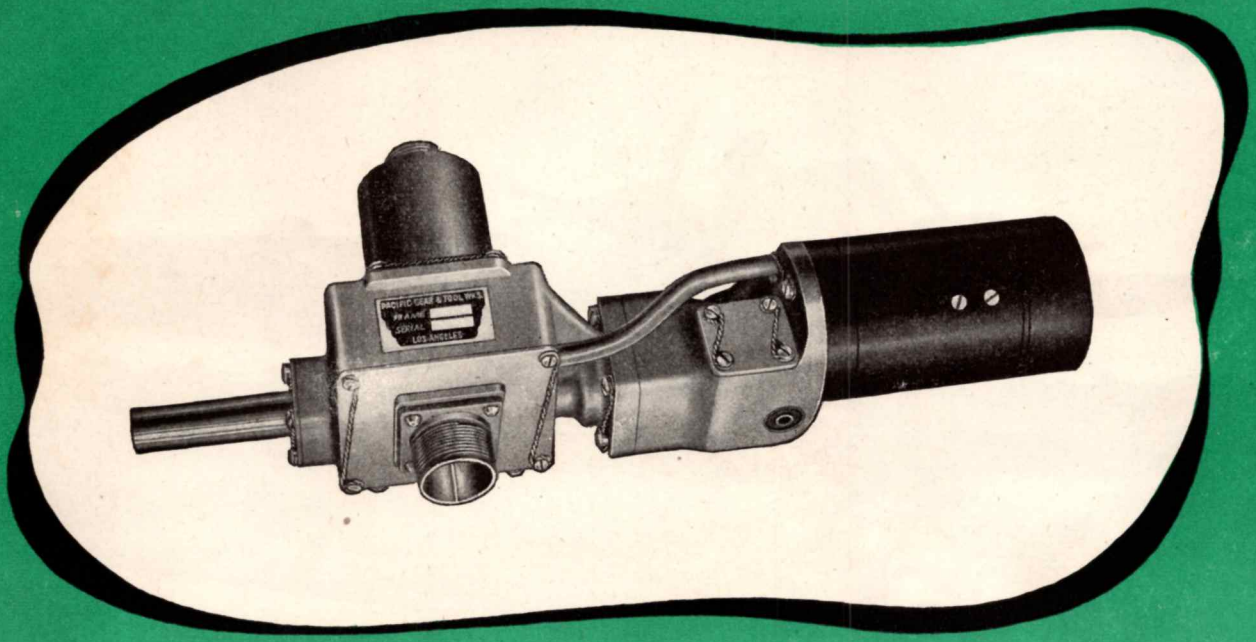
INTRODUCING



PACIFIC ACTUATORS

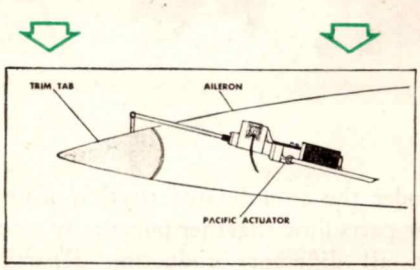
This little fellow makes the Bombardier's shots truer

Our new warplanes are rapidly eliminating all manual controls and here is one of the best new units to help in that job.

It is a Pacific Model E-1156 trim tab actuator. At finger-tip controlled button the pilot regulates the action of his ship and keeps it perfectly steady on the bombing run. This small electric actuator takes over the manual task of operating the tab in elevator, aileron or rudder. It provides linear motion of 1½-in. on its shaft and will operate under tension or compression load of 450-lbs. It weighs but 4½-lbs. (approx.)

This is but one of many complete Actuator units built by Pacific Gear Works. Aircraft engineers can find among those already built, tested and flown, units which will handle any auxiliary power application in modern planes. These units are normally powered by altitude tested General Electric motors but can be supplied with hydraulic motors. Our engineers are ready to tackle any problem you bring us.

FOR OIL COOLER FLAPS



PACIFIC GEAR WORKS

DIVISION WESTERN GEAR WORKS

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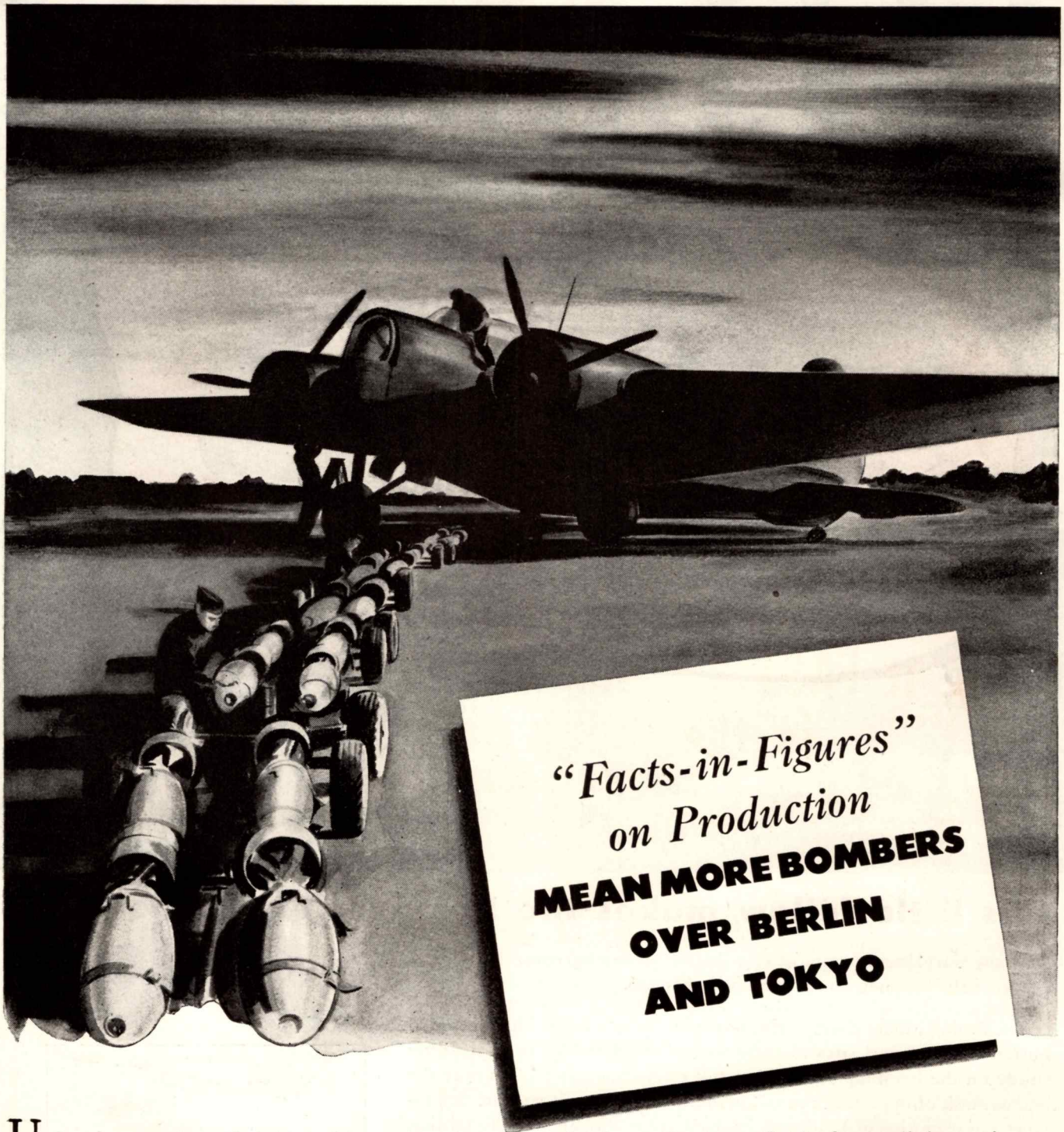
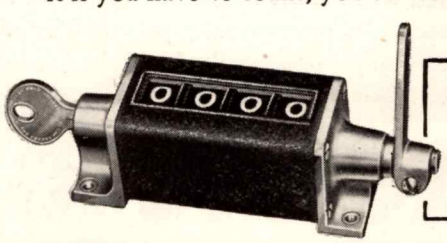
ASSOCIATED PLANTS, LYNWOOD, SEATTLE, SAN FRANCISCO



Under the co-ordinated rhythm of Control-by-Count, plane parts flow together punctually into final assembly, from all different production departments and sub-contractors . . . where Veeder-Root Counting Devices are attached to each production machine.

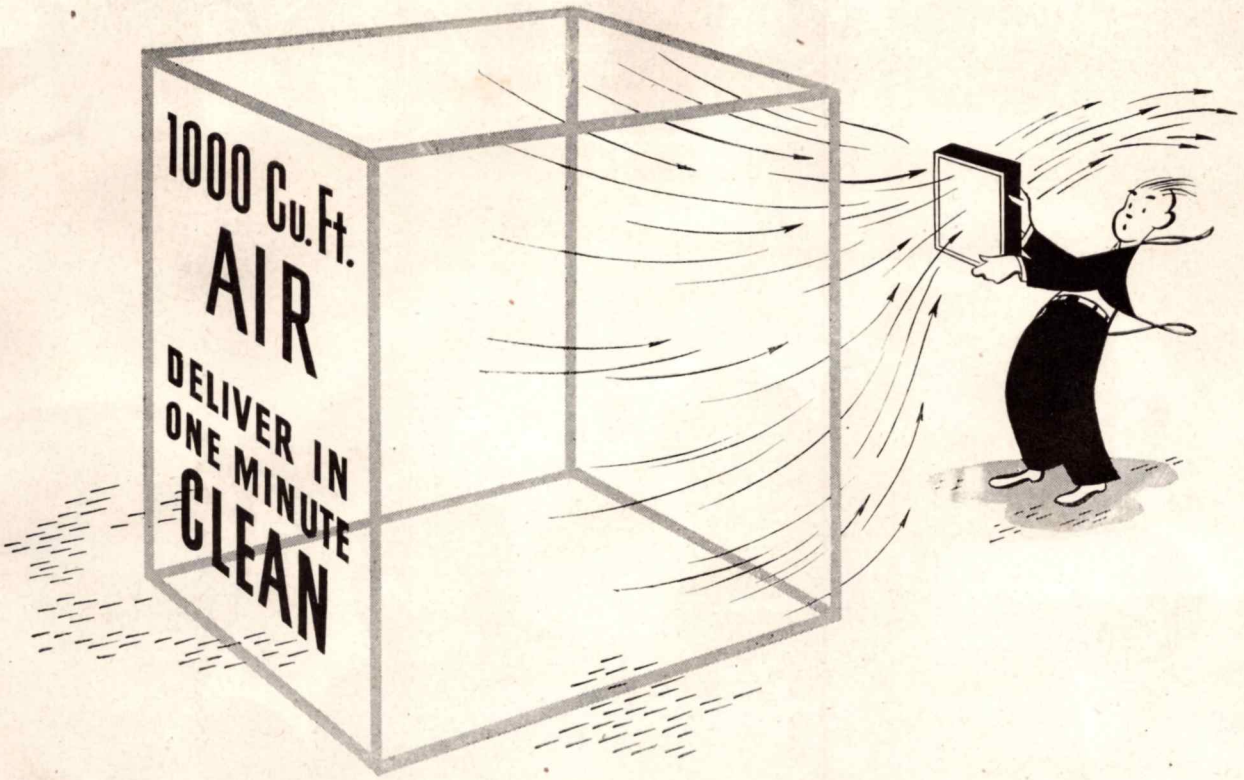
For these devices help to keep production lines booming along in step . . . by publishing plain black-and-white figures that show up any tendency to fall behind, so that corrective measures can be taken immediately, before serious harm is done. And this means that delays are avoided . . . production speeded from all quarters . . . which adds up to more planes off the line and in the air over the enemy, day by day, until the war is won. *You* can get Veeder-Root Counting Devices . . . mechanically or electrically operated . . . to furnish facts-in-figures on all your production machines and processes. Whatever it is you have to count, you can count on us to count it.



Key-Reset Revolution or Direct-Drive Counter

Veeder-Root Incorporated

HARTFORD, CONNECTICUT



Doing it FAST is the tough part

It's one thing to de-dust a gentle breeze ambling through a few inches of filter, and another to pick grit out of a tornado. In many planes today you've got about one-thousandth of a second to do it.

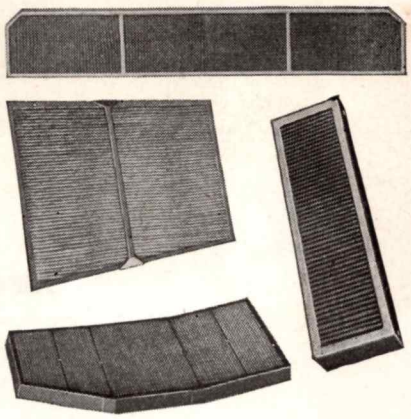
Cleaning air this quickly is where Air-Maze aircraft filters come in especially handy.

The reason lies in a patented *lightweight*, crimped filter medium of special materials. By arranging the crimps of the mesh precisely, a relatively open construction is able to break up the air stream and force it to impinge against viscous-charged baffle wires.

The results are better cleaning and less restriction of intake air, even under severe dust conditions and at high velocities. Added advantages of Air-Maze aircraft filters include larger dust-holding capacity per square foot of filter area, unusual lightness, resistance to vibration and ease of cleaning.

Our engineering service is available to design and build aircraft filters to meet your needs.

A Few Typical AIR-MAZE *HIGH-VELOCITY* Aircraft Engine Filters



How much Lighter?

We will gladly tell you the advantages of weight savings and efficiency of Air-Maze filters. Include engine and installation data with your inquiry.

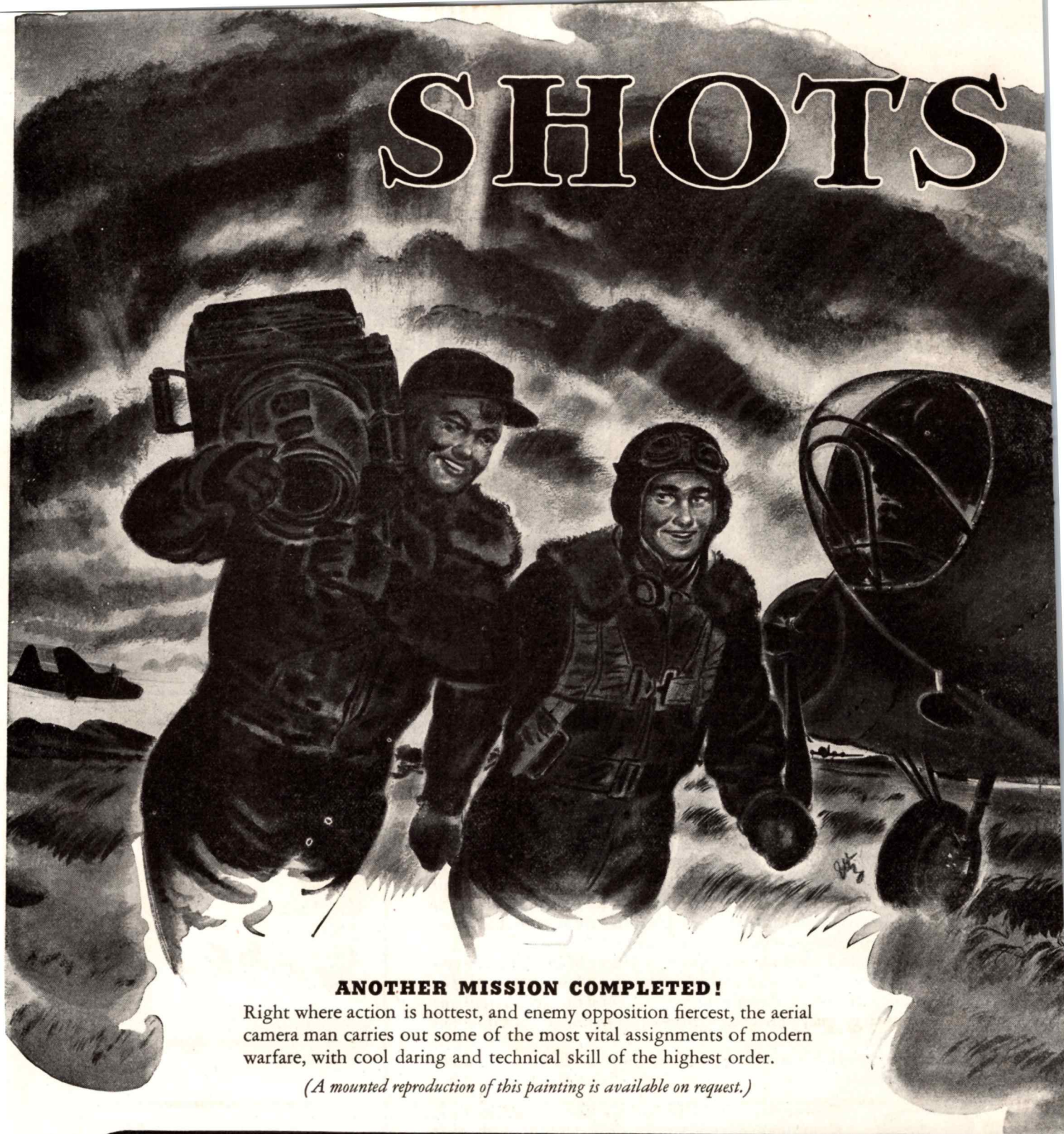
Generator air filter for air-borne application. Combines exceptionally light weight with high dust-arresting ability. This is one of many special types of filters designed and built by Air-Maze for the aviation industry. Have you a problem?

AIR-MAZE CORPORATION • CLEVELAND, OHIO

AIR-MAZE

SPECIALISTS IN AIR FILTRATION

SHOTS



ANOTHER MISSION COMPLETED!

Right where action is hottest, and enemy opposition fiercest, the aerial camera man carries out some of the most vital assignments of modern warfare, with cool daring and technical skill of the highest order.

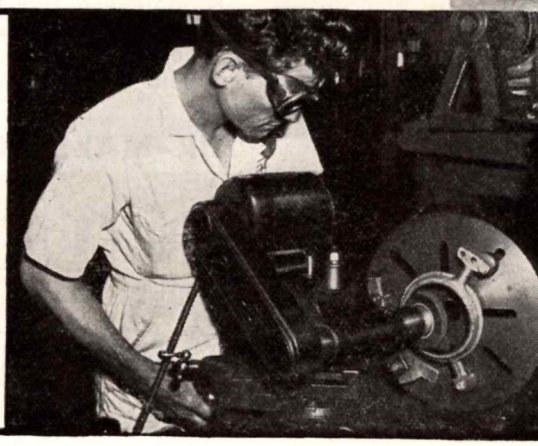
(A mounted reproduction of this painting is available on request.)

Dumore

PRECISION GRINDERS

FOR BETTER

MAINTENANCE AND REPAIR



FOR G-2

WHEREVER there is *action*—reconnaissance cameras, eyes of the army intelligence, are rolling to spot the target, direct the attack and record the results. To secure the most accurate and informative shots for "G-2", camera shutters click or strip film reels past the lens aperture, in precise relation to the plane's speed and height. Such precision is obtainable only through the aid of specially designed electric motors.

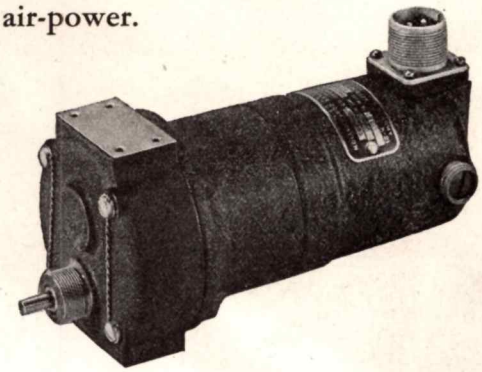
For such vital purposes, Dumore engineers have developed more than 30 special aviation type fractional horsepower motors, smaller, lighter, more powerful, than were thought possible only a short time ago. They operate de-icer equipment, ammunition boosters, retractable landing gear, and a wide range of different, but essential accessories, calling for gear reductions, clutches, brakes, gas-proof enclosures, and other special features. Including these accessories, and balancing the weight and space restrictions against the power needs, was a triumph of Dumore engineers. A parallel achievement was the volume production of these motors, to speed the growth of our fighting air-power.

"FIRST ASSISTANT CAMERA MAN"

Aerial photography is largely automatic through the use of special types of motors such as Dumore has developed for operating shutters, timing the exposure, developing the film and processing the picture.

On applications where overtravel must be held to a minimum, such as aerial cameras, retractable landing gears, cowl flaps, Dumore developed a combination magnetic clutch and brake, to bring the output shaft to a stop within ½ second when the circuit is opened. Gear reduction units are also included, and the motors are conditioned to operate over wide temperature and altitude ranges.

Dumore engineers are well equipped to aid you in the application of fractional horsepower motors.



FOR EXTRA POWER HOURS

Dumore

Headquarters for
Fractional Horsepower Aircraft Motors

PUT FACTORY ACCURACY IN FIELD MAINTENANCE

Aerial supremacy demands fighting planes built and maintained to highest possible standards. What price precision in manufacture, if the working parts cannot be kept at their original efficiency? Light weight, mobile equipment combining precision and flexibility enables the skilled ground crews to perform near miracles in the field. Here, Dumore Precision Grinders are giving them a ten-thousandth of an inch accuracy, as surely as they do back at the factory. Mounted on any available machine base, Dumore grinders perform any grinding operation, external or internal, to a depth of 24 inches, at speeds up to 42,500 r.p.m.

Dumore distributors, located in all principal cities, can give you complete details on capacities of various models — or write for complete catalog, today!

THE DUMORE COMPANY, RACINE, WISCONSIN

POWER TO WIN

Thousands have earned their wings with dependable Continental Red Seal Power, and these famous Red Seal Engines have always inspired a trusting confidence in the hearts of men learning to fly.

Your Dollars Are Power, Too . . . Buy War Bonds

ARMY E NAVY

Awarded to the Detroit and Muskegon Plants of Continental Motors Corporation for High Achievement.

Continental Motors Corporation
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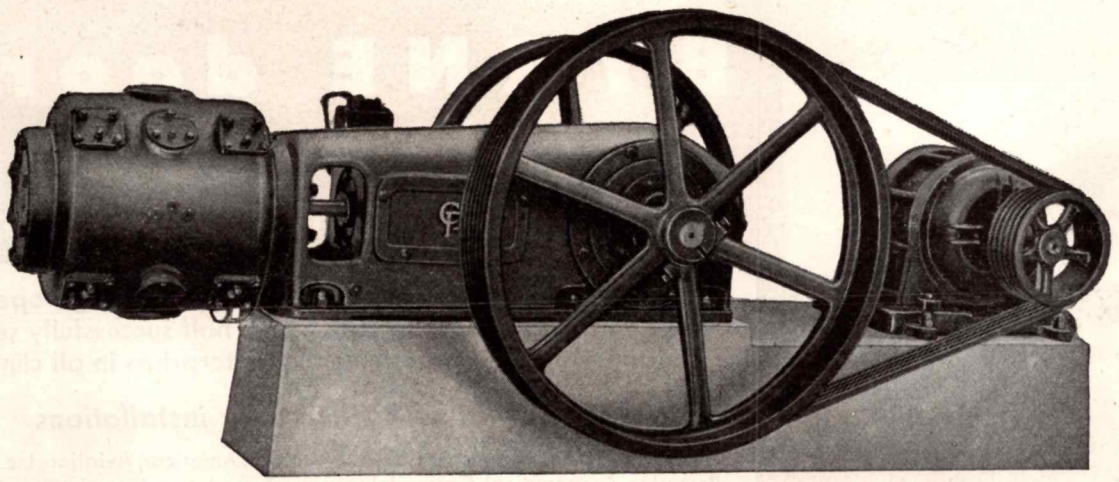
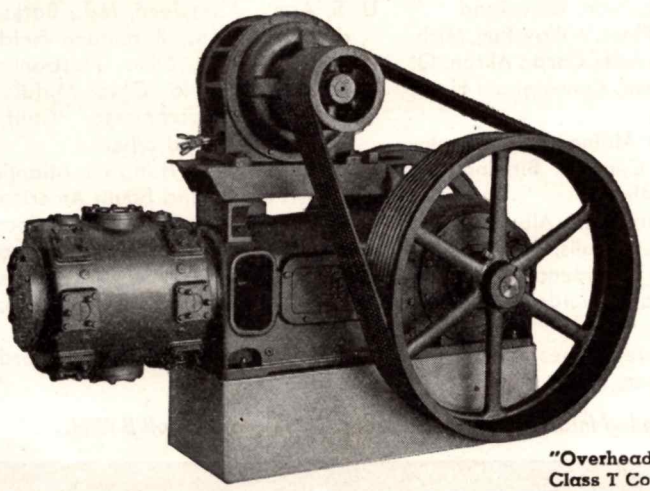
A Heavy Duty COMPRESSOR

FOR TWENTY-FOUR HOUR SERVICE



Available For Quick Deliveries



"Overhead "V" belt drive ideally adapts Class T Compressor for use where space is limited."

Chicago Pneumatic Class T Compressors are built in a wide range of sizes . . . 15 to 125 h.p. . . . in single or multi-stage designs . . . for pressures up to 5,000 pounds . . . "V" belt, synchronous motor or steam drive. Also available with "Oilless" cylinder for use where compressed air must be free of oil. Send for Bulletin 728.

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AIR COMPRESSORS
VACUUM PUMPS
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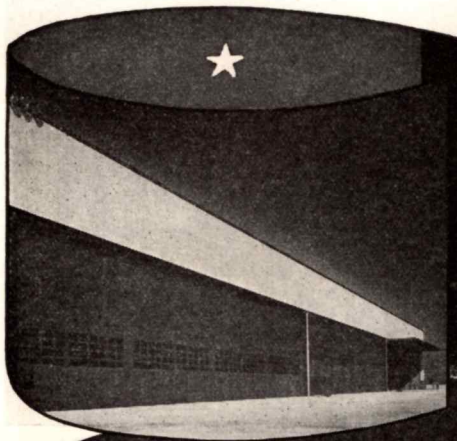
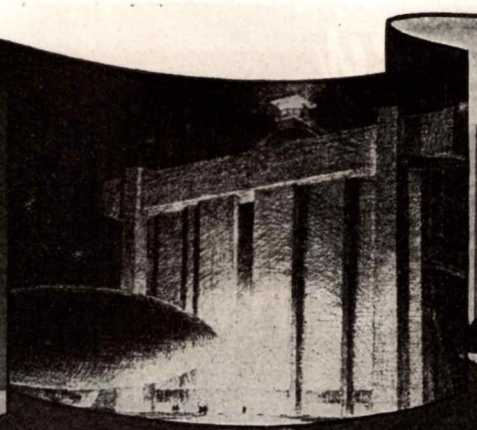
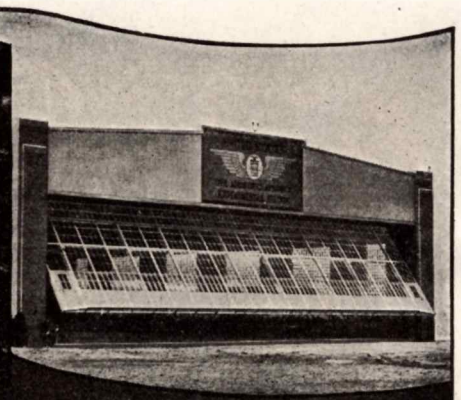
AVIATION ACCESSORIES



BYRNE canopy type K doors . . . for openings of any width and up to 55 ft. high.



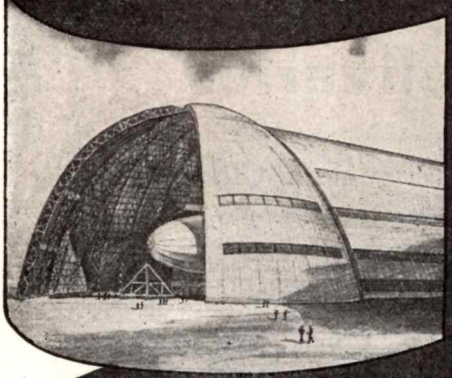
BYRNE motorized slide doors 12 stories high . . . used in many Navy dirigible hangars.



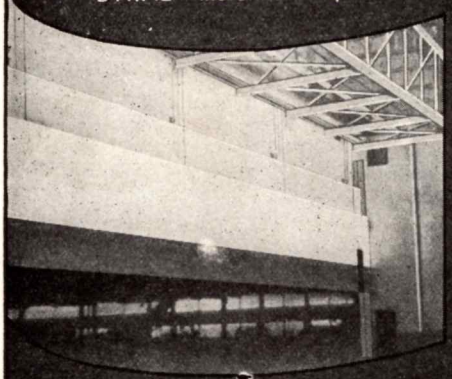
BYRNE canopy type B hangar door . . . for openings up to 120 ft. by 30 ft.

BYRNE doors
Serve the Americas . . .
from North to South, Coast to Coast!

A flip of a switch operates BYRNE motorized slide doors for aircraft hangars.



Mammoth dirigible hangar doors . . . 320 ft. by 196 ft. . . . with BYRNE motorized operators.



BYRNE doors for every industrial use . . . crane entrances, movable partitions, shipping doors.

BYRNE doors, engineered for every type of large opening, have for more than a decade and a half successfully served the armed forces and commercial enterprises in all climates.

Partial list of BYRNE door installations

American Air Lines, Chicago.
Brewster Aeronautical Corp., Johnsville, Pa.
C.A.A., Indianapolis, Ind.
Consolidated Aircraft Corp., New Orleans.
Curtiss-Wright Corp., Columbus, O., and Louisville, Ky.
Fisher Body Division, Cleveland.
Ford Bomber Plant, Willow Run, Mich.
Goodyear Aircraft Corp., Akron, O.
Marine Air Base, Cunningham Field, N. C.
Mid-Continent Airlines, Minneapolis.
Modification Centers, Birmingham, Ala., and others.
Municipal Airports, Albuquerque, N. M.; Great Falls, Mont.; Pittsburgh, Pa.; Providence, R. I.
National Guard Fields throughout the country.
Naval Reserve Bases, Gardner, Kan.; Norman, Okla.
North American Aviation, Inc., Dallas, Texas, and Kansas City, Mo.
Northwest Airlines, Chicago and Minneapolis.
Ranger Aircraft Div., of Fairchild, Farmingdale, N. Y.
Republic Aviation Corp., L. I., N. Y.
TWA Hangar, Kansas City, Mo.
U. S. Army Aberdeen, Md.; Barksdale Field, La.; Borinquen Field, P. R.; Dayton, Ohio; Fairbanks, Alaska; Fairfield, Ohio; Middleton, Pa.; Sacramento, Calif.; Tampa Fla., and others.
U. S. Naval Patrol Hangars, Atlantic Coast, North and South America.
U. S. Navy, Alameda, Calif.; Coco Solo, Canal Zone; Guantanamo, Cuba; Norfolk, Va., and others.
U. S. Navy Dirigible Hangars on both coasts.
Vought-Sikorsky Aircraft, Stratford, Conn.

For detailed information, see Sweet's Catalog or consult BYRNE.

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incorporated

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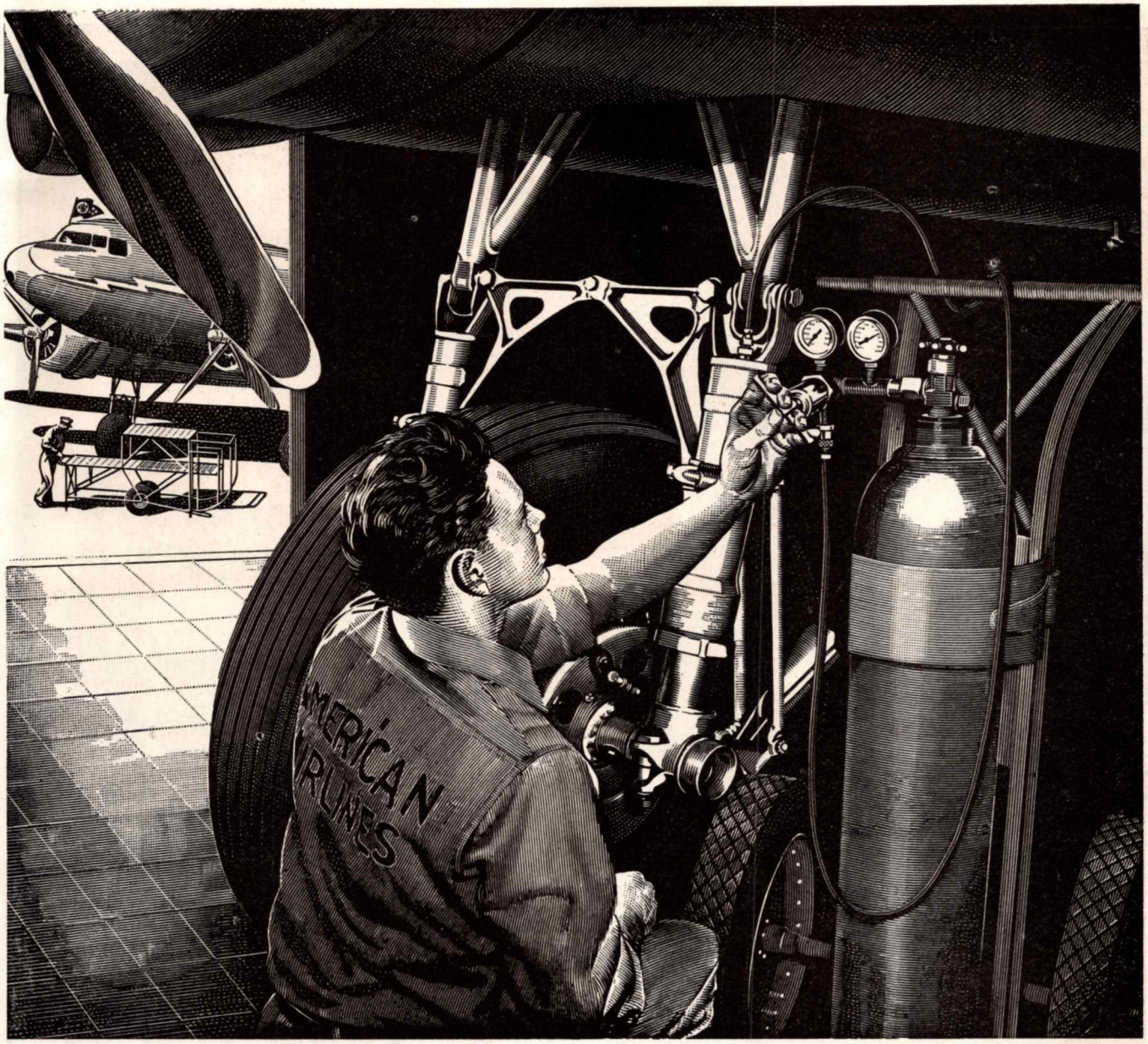

CUSHIONING *Flagships* FOR EASY LANDINGS

PREPARING big airliners for easy landings requires careful attention to many mechanical details. For example, it is most important that a constant and proper pressure be maintained on the oleo struts of the landing gears—and on the American Airlines' "Flagships," an Airco gas regulator does the job accurately.

The same method is used to control the air pressure which balances the hydraulic system for operating landing flap brakes and retractable landing gear—and on many airlines Airco nitrogen is the gas used for this purpose.

These are just two of a large number of operations which link Air Reduction with the aviation industry. For instance, Airco oxygen regulators aid stratosphere flying... Airco and Wilson electric welding equipment speed construction of sturdy jigs and fixtures in airplane factories... Airco gas welding and cutting torches play leading parts in the manufacture of numerous aircraft parts.

Through these products, and through its research and Field Engineering Service, Air Reduction is helping to facilitate aircraft operation, production, and maintenance. For detailed information or technical aid, write your nearest Air Reduction office.

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IDLE CYLINDERS ARE PRODUCTION SLACKERS: KEEP 'EM ROLLING FOR VICTORY!

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AIRCRAFT BALL BEARINGS
PROVIDE
DEPENDABLE, RELIABLE
CONTROL

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ON EVERY FIGHTING FRONT THESE
PRECISION BALL BEARINGS ARE
DOING AN OUTSTANDING JOB FOR
THE AIR FORCES
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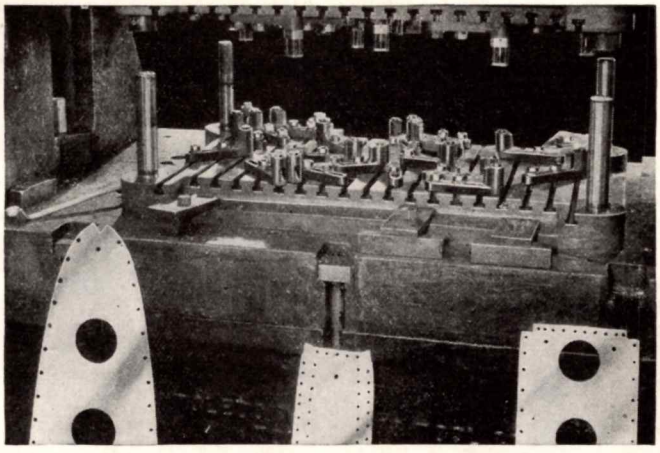
YOU COULDN'T ASK FOR ANYTHING MORE SIMPLE — OR BETTER THAN

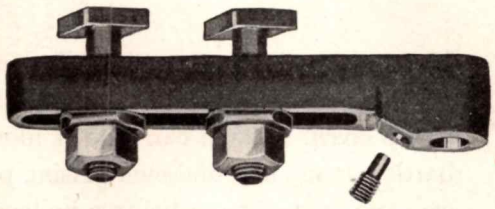
WHISTLER ADJUSTABLE PUNCH and DIE UNITS

Whistler Adjustable Dies work on any type press and because of their simplicity even new workers quickly learn to make pattern change-overs—increasing productive press hours. Absolute precision on short or long runs. Whistler design permits more perforations in a given area—often reducing press operations. For quick and complete information on the advantages of Whistler Adjustable perforating and notching dies send a description or drawing of your work.



These pieces produced with Whistler Adjustable Dies clearly illustrate the re-use of same punch and die units.

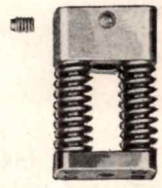
These photographs show the simplicity of a Whistler Adjustable Punch and Die assembly. Every piece is interchangeable.



Self-locking bolts on punch holder drop into T slots of die shoe. Set-screw engages into recess at base of punch. Punch cannot turn or pull out in operation.

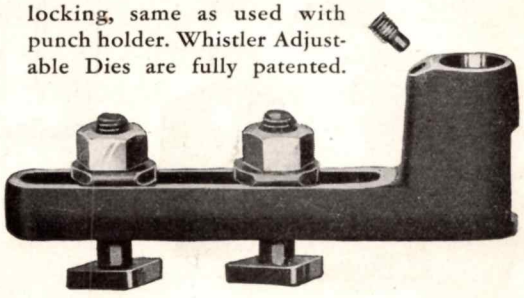
Punches of finest tool steel are machined to .0001″ tolerances.

Stripper unit fits smoothly over punch—no "wobble". Flushed set-screw engages into groove on punch body. Stripper or punch quickly removed when desired.



Grooved heads on dies make lifting from holder quick and easy. Like the punches, dies are held firmly into holder by set-screw in recess at base. Whistler *precision* is known the world over.

Die holder has self-cleaning slug chute. Special design bolt heads present two bearing surfaces to T slot channel—self-locking, same as used with punch holder. Whistler Adjustable Dies are fully patented.



Write for the Whistler Catalog—every Production Executive should have it.

S. B. WHISTLER & SONS, Inc.

Over 25 Years of Tool and Die Making Experience

752-756 MILITARY ROAD **BUFFALO, N. Y.**

7 things you should do to keep prices down!

If prices soar, this war will last longer, and we could all go broke when it's over. Uncle Sam is fighting hard to keep prices *down*. But he can't do it alone. It's up to *you* to battle against any and every rising price! To help win the war and keep it from being a hollow victory afterward—you must *keep prices down*. And here's how you can do it:

1. BUY ONLY WHAT YOU NEED

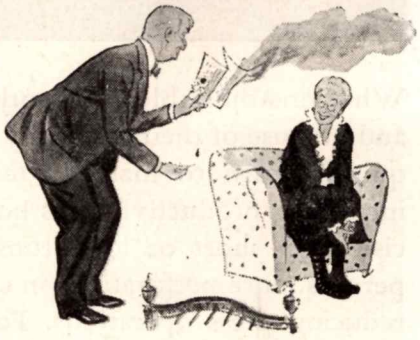
Don't buy a *thing* unless you *cannot* get along without it. Spending can't create more goods. It makes them scarce and prices go up. So make everything you own last longer. "Use it up, wear it out, make it do, or do without."

2. PAY NO MORE THAN CEILING PRICES

If you do pay more, you're party to a black market that boosts prices. And if prices go up through the ceiling, your money will be worth less. Buy rationed goods only with stamps.

3. SUPPORT HIGHER TAXES

It's easier and cheaper to pay for the war as you go. And it's better to pay big taxes *now*—while you have the extra money to do it. Every dollar put into taxes means a dollar less to bid for scarce goods and boost prices.

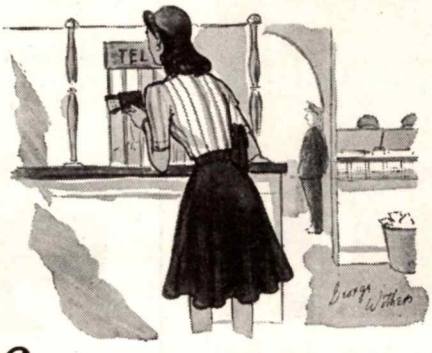


4. PAY OFF OLD DEBTS

Paid-off debts make you independent now . . . and make your position a whale of a lot safer against the day you may be earning less. So pay off every cent you owe—and avoid making new debts as you'd avoid heiling Hitler!

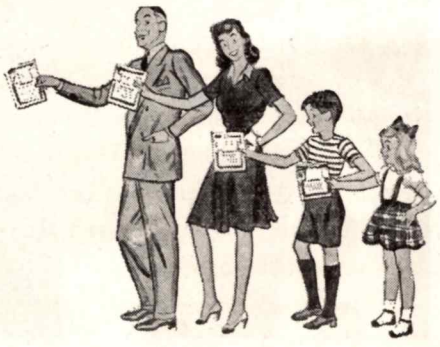
5. DON'T ASK MORE MONEY

in wages, or in prices for goods you have to sell. That puts prices up for the things all of us buy. We're all in this war together—business men, farmers and workers. Increases come out of everybody's pocket—including *yours*.



6. SAVE FOR THE FUTURE

Money in the savings bank will come in handy for emergencies. And money in life insurance protects your family, protects you in old age. See that you're ready to meet any situation.



7. BUY WAR BONDS

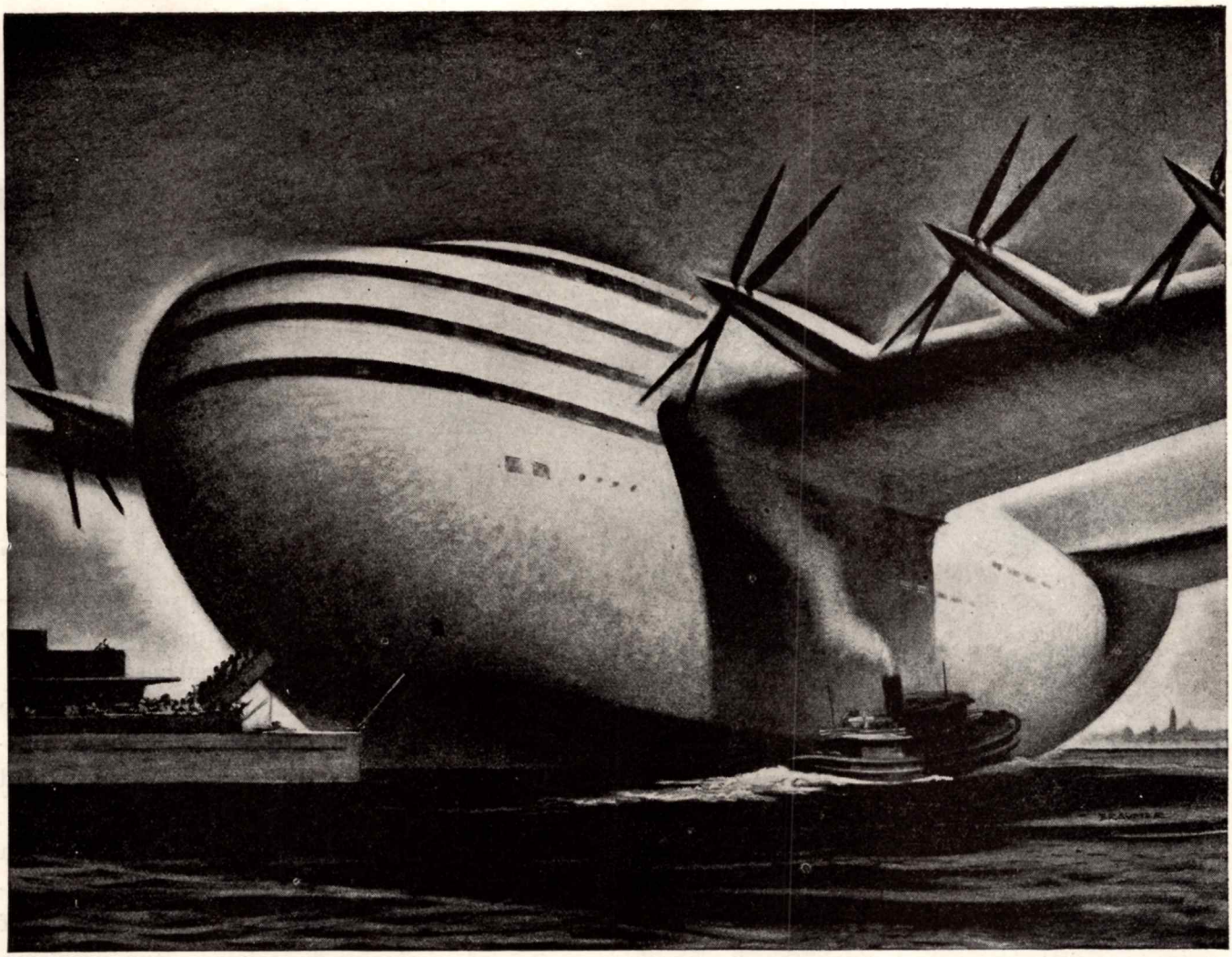
and hold them. Buy as many as you can. Then cut corners to buy more. Bonds put money to work fighting the war instead of letting it shove up prices. They mean safety for you tomorrow. And they'll help keep prices down today.

KEEP PRICES DOWN . . .

Use it up . . . Wear it out . . .

Make it do . . . Or do without.

This advertisement, prepared by the War Advertising Council, is contributed **by this** magazine in cooperation with the Magazine Publishers of America.



Tomorrow . . . wait and see!

WE KNOW NOW there is no real physical limit to the carrying capacity of the airplane. Two-hundred ton planes are actually on the drawing boards. Far bigger ones are taking definite form in the minds of aeronautical engineers, whose designs are no longer confined to pigmy proportions by fuel limitations.

Houdry scientists have contributed mightily to this freeing of creative imaginations. They have developed a revolutionary new catalytic refining process which can produce a *super* aviation fuel, incomparably better than any now being made anywhere in the world. So vastly superior that aircraft engines of current design cannot fully use its capabilities.

But when this new *super* fuel flies the plane of the future, its incredible power-producing qualities will tremendously increase lift and load carrying capacity, improve maneuverability and speed. Shorter take-offs and landings will make practicable the operation of super-size aircraft.

Thus this latest Houdry development may well influence the future of flight as profoundly as earlier Houdry developments have affected the past. In this war, more than 90% of *all* the catalytically cracked gasoline produced for the United Nations has been made by Houdry processes!

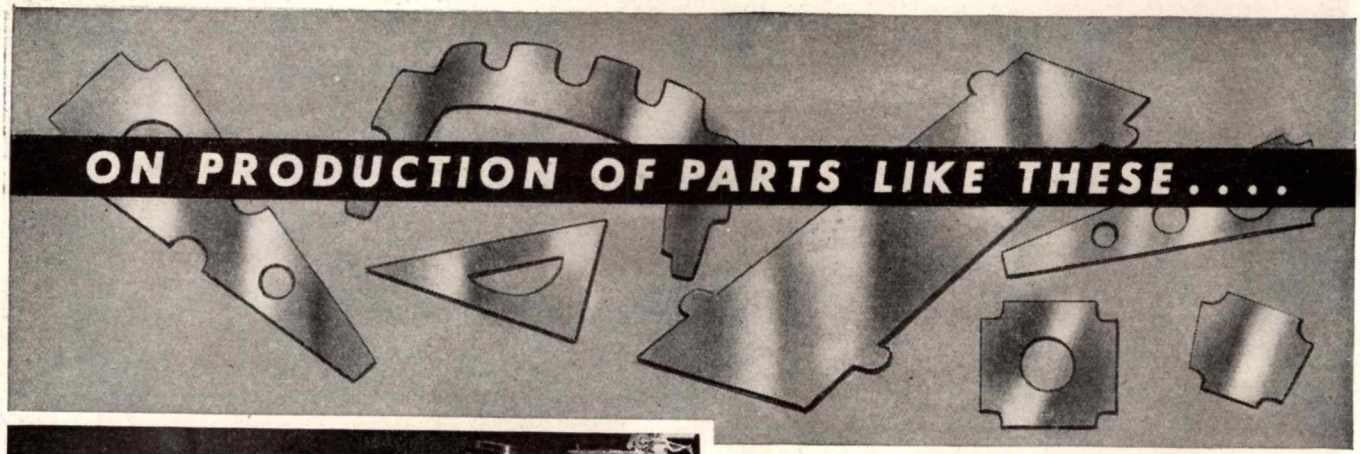
Houdry Catalytic Processes and the Thermofor Catalytic Cracking Process are available to all American refiners, under license arrangements, subject to approval by the United States Government.

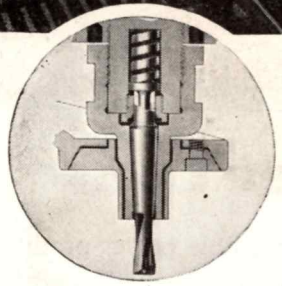
HOUDRY CATALYTIC PROCESSES
... FOR VICTORY IN WAR
... FOR PROGRESS IN PEACE

HOUDRY PROCESS CORPORATION, WILMINGTON, DELAWARE

Licensing Agents:—

E. B. BADGER & SONS CO. • Boston, Massachusetts
BECHTEL-McCONE-PARSONS CORP. • Los Angeles, California
THE LUMMUS COMPANY • New York City, New York

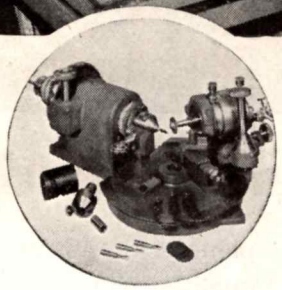




Patented Taper Chuck

This new Onsrud chuck design eliminates long over-hang and increases chucking grip. Close chucking gives the bit increased rigidity, eliminating all "whip" and reducing bit-breaking vibration.

Because the Inverted Taper Shank Bit used is always perfectly centered and correctly chucked, life of bits and spindle bearings is increased. The over-all result is faster, smoother cutting, easier feeding of bit, and less operator effort to do the work.



Onsrud Spiral Bit Grinder

With the GF-41 Spiral Bit Grinder, spiral router bits with straight or taper shanks are sharpened speedily and with factory-like accuracy and precision in your own shop.

In operation, bit is held in chuck and moved to and from the grinding wheel by a hand lever. Cam provides proper bit lead. Entire motor assembly swivels for correct adjustment to any grinding angle.

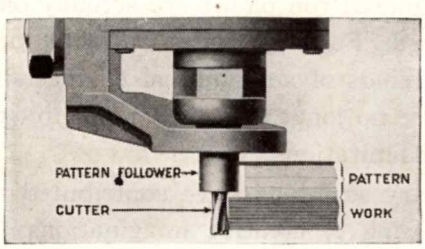
Full details on this high-speed, air-powered unit sent on request.

THIS TRIO SAVES TIME—LABOR—MATERIAL

High speed production routing of irregularly-shaped non-ferrous parts is possible with the three Onsrud products described here.

The Onsrud Radial Arm Router has a spindle speed of 15,000 RPM for smoother, faster routing of both inside and outside cuts. Completed work has clean, finish-smooth edges.

Onsrud machines and tools pioneered high speed, fast feed working of non-ferrous material. It will probably pay you to get the help of Onsrud engineers in solving your problems. Write today for "Tricks and Tips on Radial Arm Drilling and Routing" and for further information on Onsrud methods and how they may be applied to your operations.



Here's how the Onsrud Radial Arm Router cuts parts from stacked, flat or corrugated sheets. A pattern is fixed to the sheets and the pattern follower travels along the pattern's side. Both inside and outside cuts are made accurately and speedily.

Onsrud

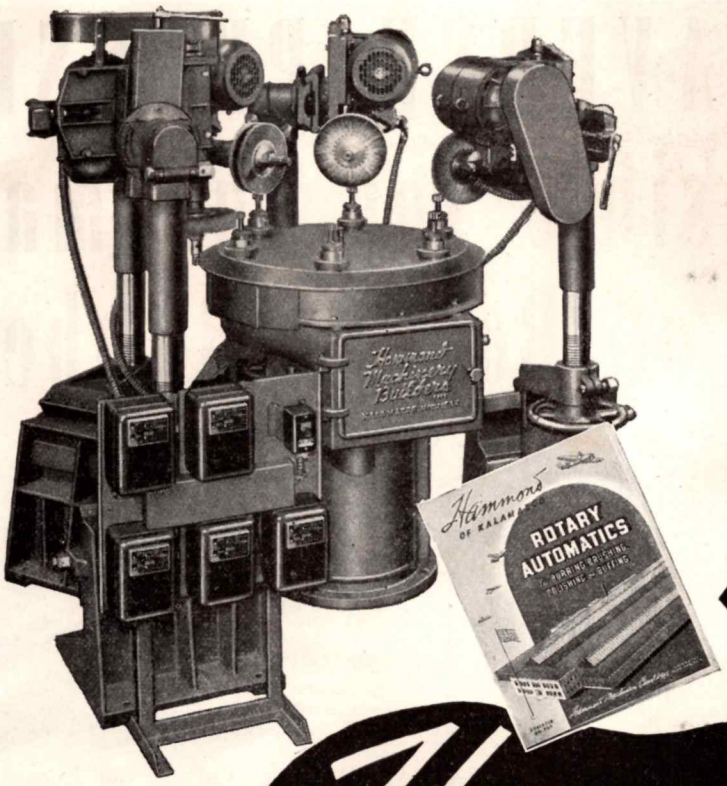
ONSRUD MACHINE WORKS, INC.

3935 Palmer Street Chicago, Illinois

Sales Offices in all Principal Cities

Machine and equipment illustrated fully protected by patents numbered 2-280-299, 1-991-623, 469-158, 474-357 and patents pending. All infringements of our rights will be diligently prosecuted.

MACHINE TOOLS AND METHODS FOR TOMORROW'S PRODUCTION



Model SB-6
For Brushing Operation
on Steel Pinion-Gears

Hammond

ROTARY AUTOMATIC

For DEBURRING, BRUSHING POLISHING or BUFFING OPERATIONS

HAMMOND Rotary Automatics are built in various combinations of relatively standard units and their extreme flexibility in adjustment of heads, table speeds and workholding chucks, makes them adaptable to a wide variety of parts to be deburred, polished, brushed or buffed. Today HAMMOND Rotary Automatics are saving thousands of man hours due to their extreme flexibility, making possible the finishing of a wide variety of parts formerly done by hand or by less efficient means. Write for the free 8 page bulletin No. 401 for suggestions for developing short cuts and economies in production.

FREE! 8 PAGE BULLETIN 401
SEND FOR IT TODAY

Hammond OF KALAMAZOO

FREE! 6 Page Bulletin 502
SEND FOR IT TODAY

Hammond

CYLINDRICAL POLISHER and GRINDER

for 1/4" to 9" Outside Diameters

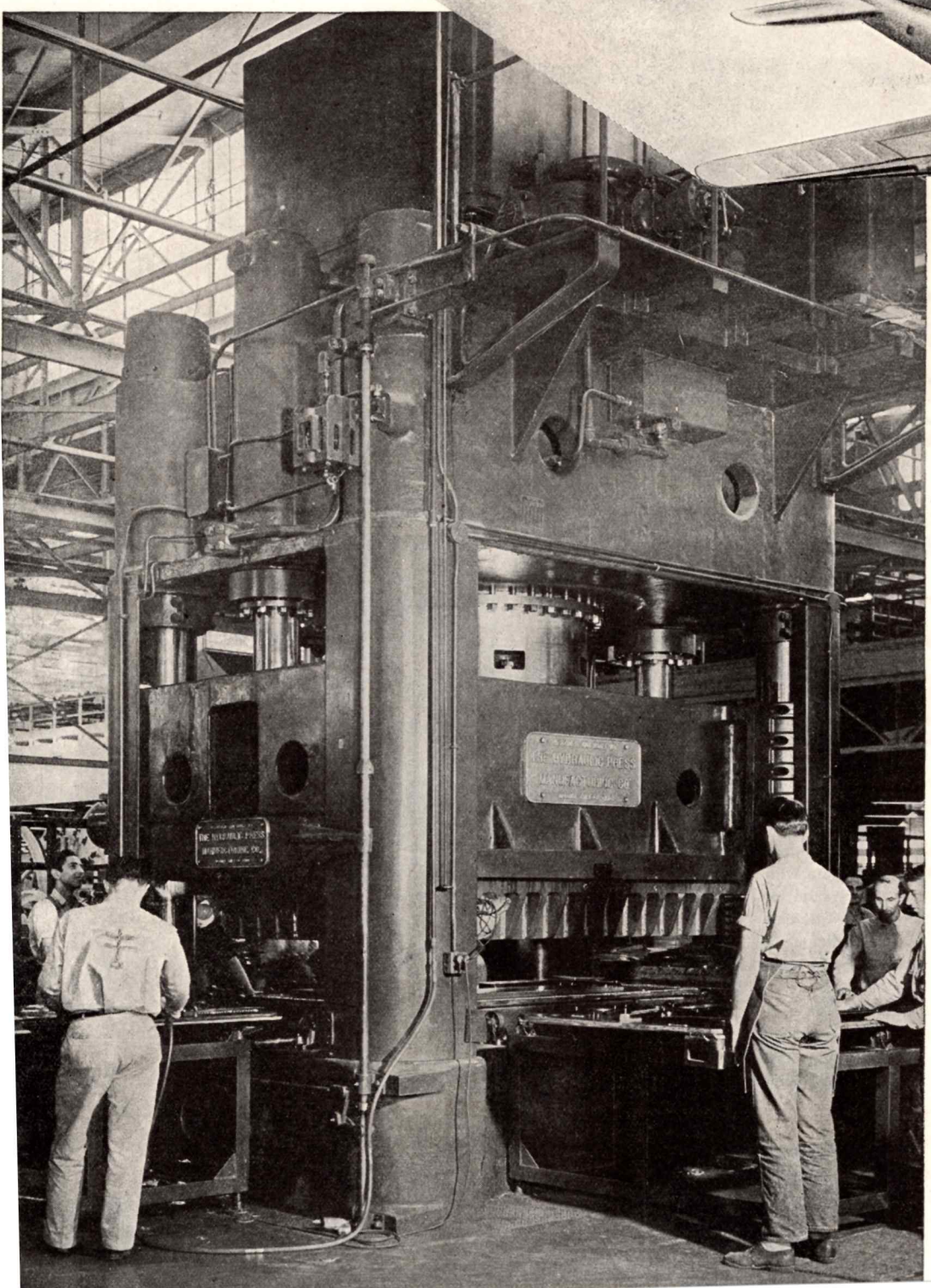
The HAMMOND Cylindrical Polishing and Grinding machine is a standard unit, engineered to operate with either wheels or abrasive belts. A wide range of finishing operations — polishing, buffing, or grinding (the removal of metal) on either base or plated metal — may be obtained on such work as tubes, rods, bars, and various cylindrical shapes.

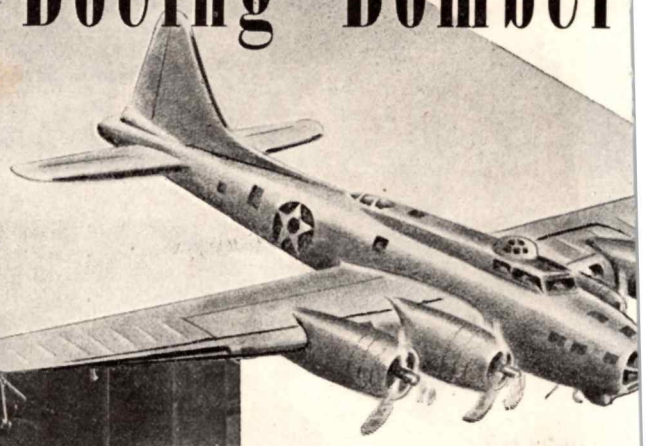
Work may be passed by hand through the area of the feed and wheel on the machine, or special work-feeding or idler-roll devices can be engineered to perform the combined action of feeding and rolling the materials into and out of the machine.

Polishing or Buffing Operation on Landing Gear Part

HAMMOND MACHINERY BUILDERS, INC.
1677 Douglas Ave. KALAMAZOO, 54F, MICH.
EASTERN BRANCH: 71 West 23rd St., NEW YORK, N. Y.

HPM FASTRAVERSE PRESSE
are responsible for the mas
production of Boeing Bomber



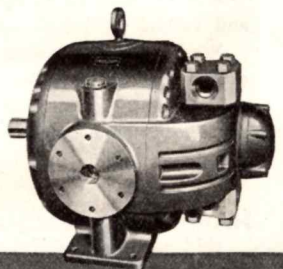


This H-P-M FASTRAVERSE rubber pad forming press is one of many H-P-M presses turning out thousands of formed metal parts for Boeing bombers and trainers. Final victory depends on the continuous operation of these presses. There is no time for shut-downs! That's why H-P-M designs and builds the hydraulic pumps for generating pressure to operate H-P-M presses. There's no chance for undivided responsibility! When you buy an H-P-M FASTRAVERSE press, you buy guaranteed press performance.

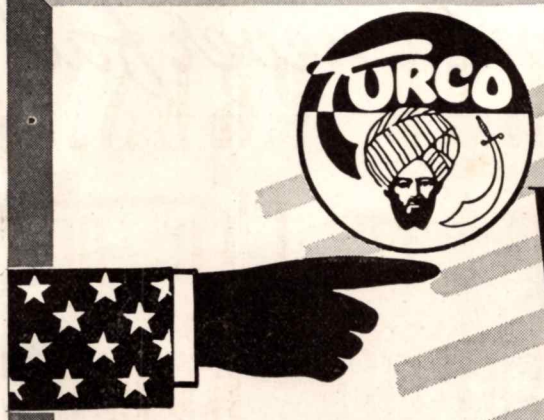
THE HYDRAULIC PRESS MANUFACTURING CO.

Mount Gilead, Ohio, U. S. A.

District Sales Offices: New York, Syracuse, Detroit and Chicago
Representatives in Principal Cities



The dependable long life H-P-M HYDRO-POWER Radial Pump powers every H-P-M Hydraulic Press



W. O. #1

THE GOVERNMENT-APPROVED PHOSPHATIZER WHICH EXCELS IN AIRCRAFT MAINTENANCE

MAKES PAINT STICK TO ALL AIRCRAFT METALS (Except Magnesium). Removes and Prevents Corrosion. For preparing aluminum and other alloy parts before painting. For removing lead stains caused by ethyl gasoline combustion.

TURCO W. O. #1, the rapid, low-cost phosphatizing method used extensively by many aircraft manufacturers, is versatile—quick and dependable in action and easy in application. This process is equally successful either for completely assembled units or for touch-up work.

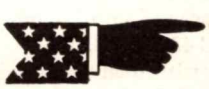
TURCO W. O. #1 provides the required passivation for aluminum and aluminum alloy surfaces, as well as all other structural metals except magnesium. It provides maximum adhesion for paint and other finishes. It inhibits rust, thus preventing oxidation of any exposed area.

TURCO W. O. #1 is easily applied by hand or by tank immersion. The customary dilution is 1 part TURCO W. O. #1 to 4 parts water. The hand method requires only the use of a sponge or brush. Rinse with clear water and wipe dry with clean rags. For smaller parts, use tank method. Immerse in solution for 15 minutes; then rinse thoroughly.

TURCO PRODUCTS, INC.

SPECIALIZED INDUSTRIAL CHEMICAL COMPOUNDS

Main office and factory, 6135 South Central Ave., Los Angeles 54. Midwest factory, 4856 South Halsted St., Chicago. Service representatives and warehouse stocks in all principal cities.



46-93

TURCO PRODUCTS, INC.
6135 S. Central, Los Angeles 54, Calif.

We want our problem solved. Send 60-page booklet "Anodizing, Chromatizing, Phosphatizing."

*Name*_____

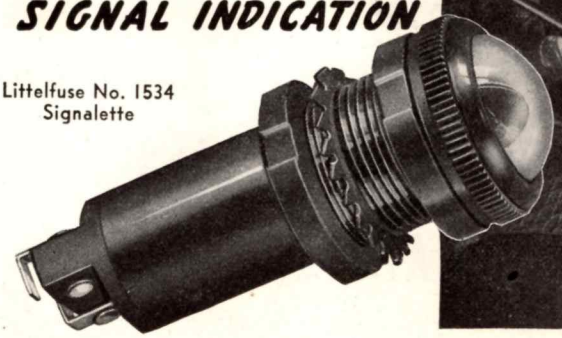
*Firm*_____

*Address*_____ *State*_____

ON YOUR LETTERHEAD, PLEASE

Where signal lights should never fail

NEW
More DISTINCT
More DEPENDABLE
SIGNAL INDICATION



Littelfuse No. 1534 Signalette

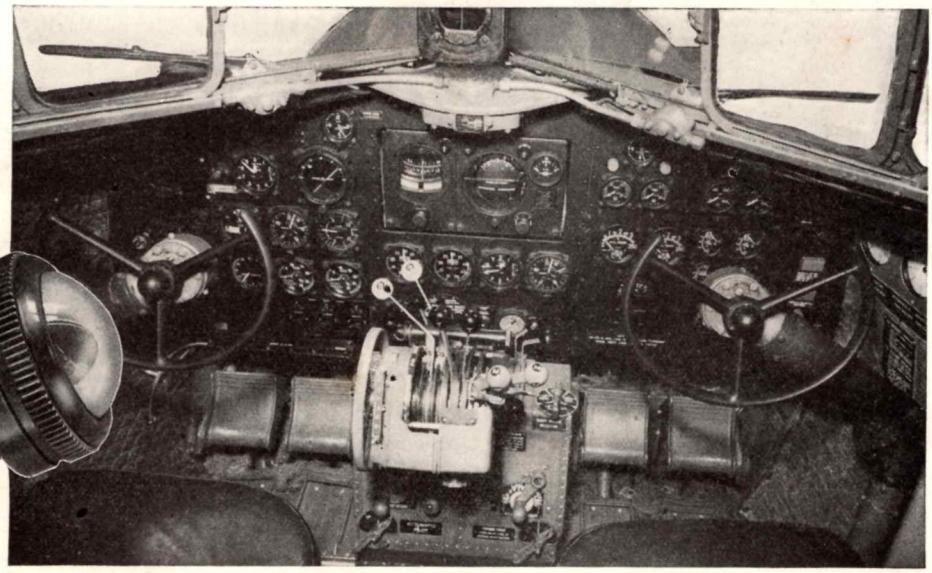
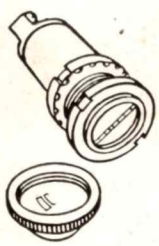


Photo illustrating typical aircraft instrument panel by courtesy of Army Air Forces Materiel Command, Wright Field.

Littelfuse SIGNALETTE

ANOTHER IMPROVEMENT BY LITTELFUSE



"BUTTERFLY" OPEN SIGNALING.

Here is a signal light that gives positive indication in brightest sunlight, or darkest night—a signal light that *adapts instantly* to the airman's eyes after looking out of cockpit—a signal light that does not require continual replacement of parts—an *always distinct* signal light without blur, glare, or dimming—a signal light that stands up in roughest going.

Outstanding Factors of LITTELFUSE Signalette

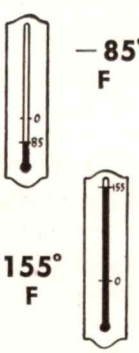
"BUTTERFLY" CLOSED NO SIGNAL.

This unit is an entirely new signal indicator for industrial uses, and for aircraft; in aircraft, for signal indication on landing gear, running gear, radio, oxygen flow, fuel and oil pressures, etc.

Signalette indicates without lamp or delicate filaments. Indication is by *reflected* light, daylight or artificial—by "black light"—and in total darkness.

When electrically energized, two vanes of a fluorescent radium-active "butterfly" instantly open, showing light signal. Signalette is furnished for signals in red, amber, green or white.

Does Away with Spare Parts



−85° F

155° F

When Signalette is installed it needs no further attention. It entirely eliminates the cost, inconvenience, and delays of replacement by spares. No spares are required. There is no fragile filament to break under vibration in a Signalette.

The Littelfuse Signalette mounts in the same space as Lamp Assembly AC 42-B-3593.

It has successfully withstood tests down to −85° F and up to 155° F—and conditions equal to the most severe in aircraft operation. Original instant response and clarity of signals have been shown in life tests in excess of 600,000 cycles.

Saves Half the Current

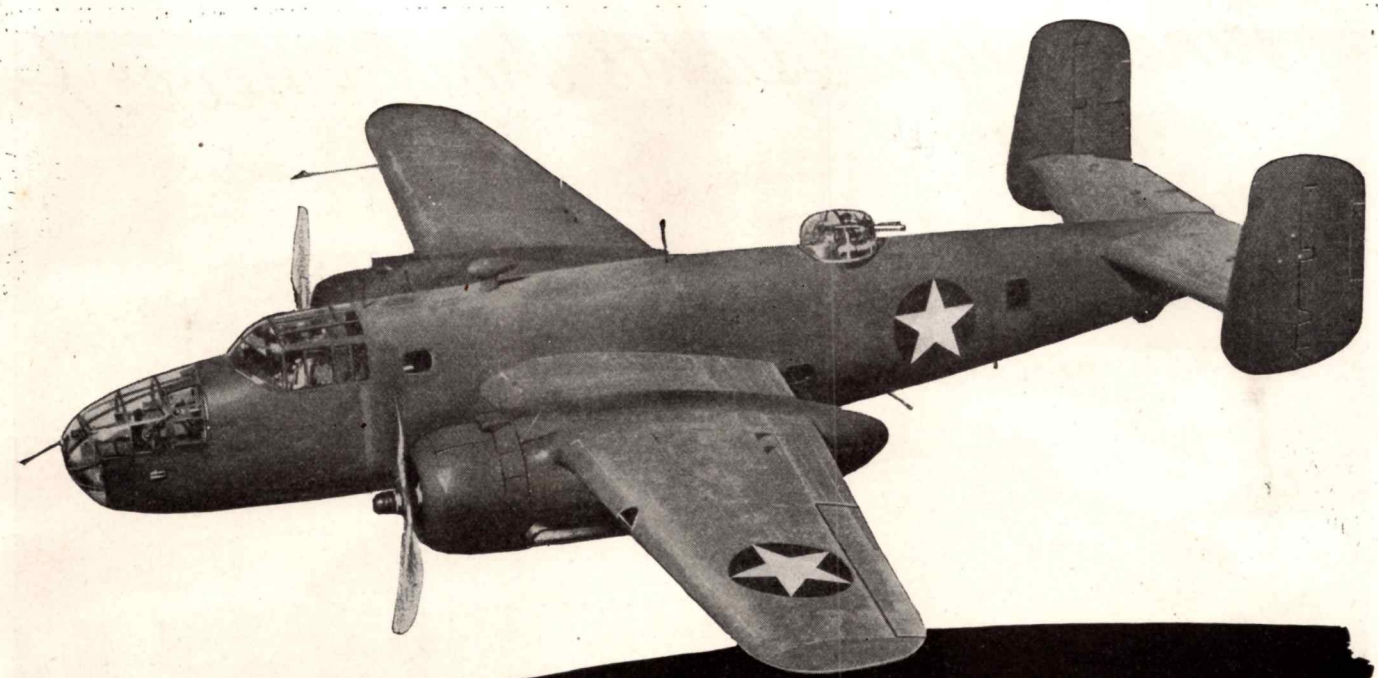
Signalette uses only 2.25 watts as against average of 4.5 watts of filament lamps. Signalette draws only .09 ampere.

Normal high voltage surges do not burn out Signalette. With its strength and construction for extreme shock—its non-shatterable plastic cap, its dependability and freedom from the necessity of spares and replacements, it sets a new standard of economy.

Send for Signalette Bulletin with complete engineering data, and information on samples for test.

Write or wire Littlefuse El Monte office for all details.

LITTELFUSE
INCORPORATED
260 Ong St., El Monte, California
4757 Ravenswood Ave., Chicago, Ill.



"ALL OF OUR PLANES RETURNED SAFELY"

WHY does this phrase appear so often in news reports of American air battles? Better pilots? Faster planes? More firepower? Better armor? But the enemy has good pilots, too, and fast, well-armored planes with high firepower.

So, it's more than that.

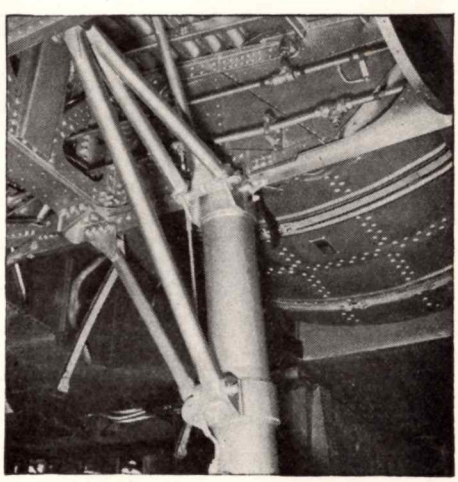
American planes are built so they can "dish it out" and—they can take punishment that would knock most enemy planes out of the sky.

From small training gliders to huge bombers, American planes are built with "sinews" of alloy steel tubes—the strongest construction known for its weight. Vital parts of the new helicopter, too, are built light and strong with alloy steel tubing.

Many times when a plane gets shot full of holes, it's the tubing that retains sufficient strength to permit ordinary flying unless some other vital part of the plane is knocked out of action.

No matter what size of round tubes you need—from ¼" to 8⅝"—Tubular Alloy Steel Corporation makes them. The sole purpose of this organization is to render the greatest possible tubular service for vital war uses.

Our experienced men, working with the most modern equipment, are turning out in increasing quantities the finest alloy steel tubing available. Made to conform to the highest standards of Government Specifications. Write for complete information about Tubular Alloy Steel Products.



SEAMLESS ALLOY STEEL TUBING ADDS STRENGTH WITH LEAST WEIGHT

Tubular alloy steel landing gear for bomber must be strong enough to withstand impact many times the weight of the bomber itself.

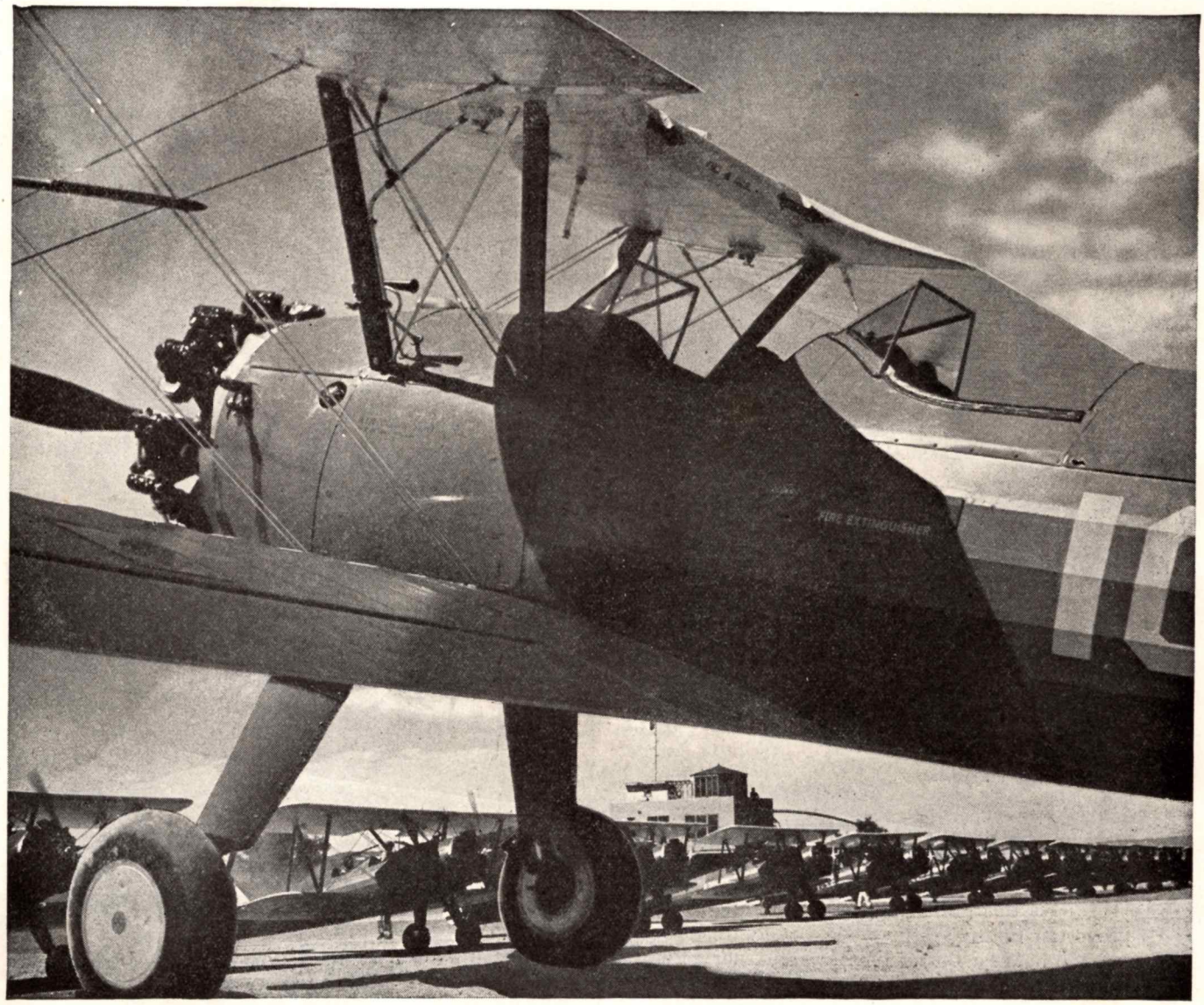
The newest name in alloy tubing

TUBULAR ALLOY STEEL CORPORATION

Gary, Indiana

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL



BORN: FEBRUARY 8, 1941 WEIGHT: 1926 LBS. 8 OZ.

I'm the Primary Trainer the Army Air Forces Spent Years to Develop. I'm Safe as a Cradle.

Officially, I'm a Boeing PT-17 Kaydet... now one of thousands. 27 months ago I was first on the flight line at THUNDERBIRD FIELD. Hundreds of cadets have nestled in my cockpit for their solo flights. 225,540 miles are behind me... 8½ times around the world... and I'm still going strong. I'm helping... right here in Arizona... to make the air safe for all the world.

Behind the Scenes is that unsung crew of mechanics that keep me ticking... keep all of us PTs ticking for thousands of hours. Every morning they check me over... check me in detail three times a month. Only once have I been off the flight line for more than a day.

I remember my first trip to "Overhaul." 1512 hours, I'd had, in the air. There, expert hands found and fixed my bumps and scratches ... again replaced my motor. This is my third, freshly overhauled... sweet-running.

No wonder I've brought cadets in safely 7,267 times... and I'm still as good as new.

Here's Why I Tell You All This. When war made expansion necessary, the Army Air Forces turned to selected civilian schools like "SOUTHWEST" for assistance. In me the flier is born. Later the fighter is made. Primary training is the foundation of it all.

Bet your bottom dollar we PTs are made and *kept* in perfect condition as part of Army's program to quickly, yet safely develop the most competent fliers in the world.

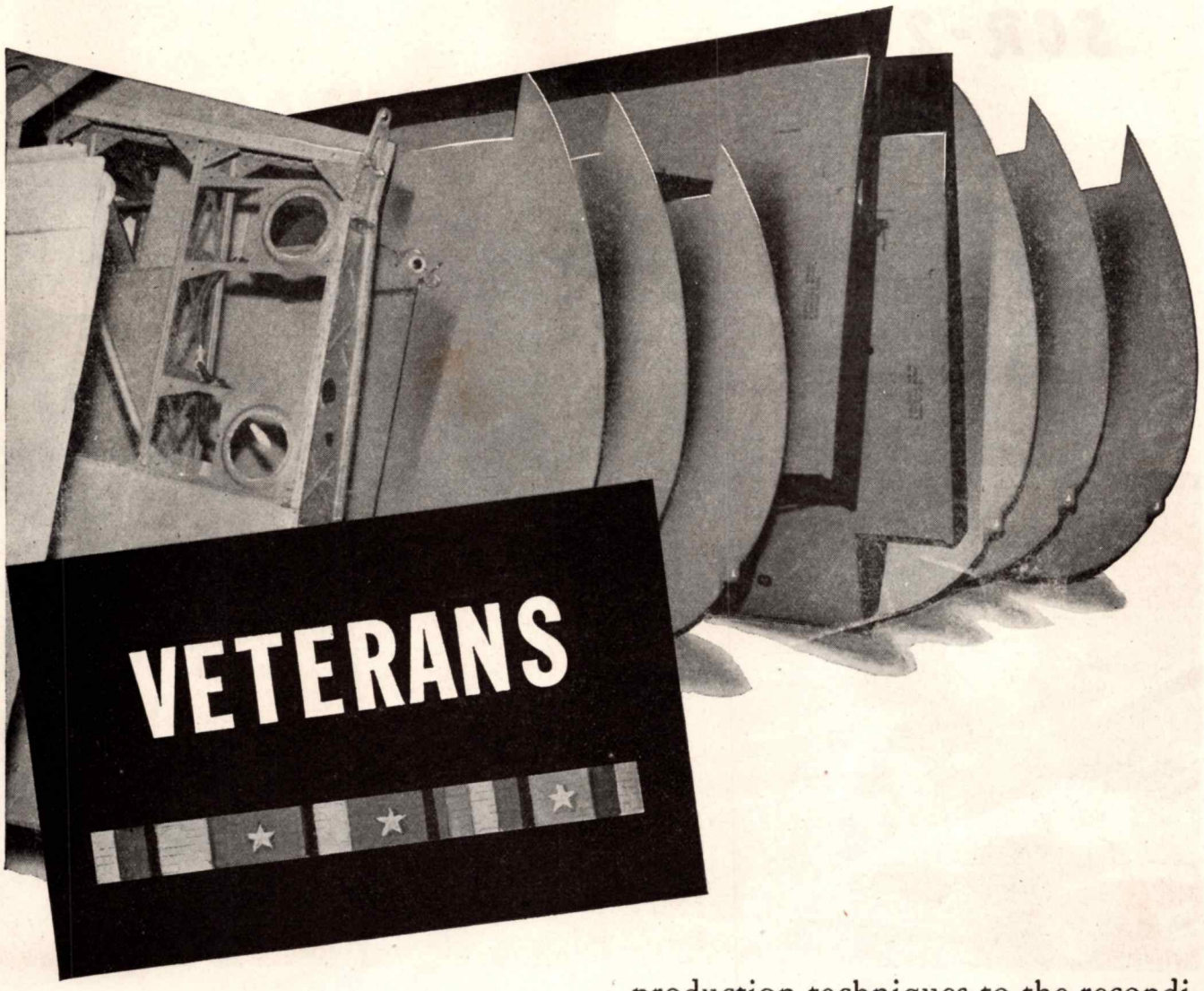
SOUTHWEST AIRWAYS

Phoenix, Arizona

THUNDERBIRD FIELD • FALCON FIELD • SKY HARBOR • THUNDERBIRD II

TRAINING THE FINEST FIGHTERS TODAY, THE FINEST FLYERS TOMORROW

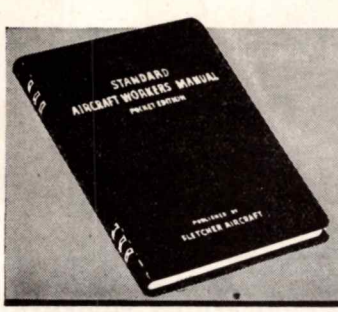
CONTRACTORS TO THE UNITED STATES GOVERNMENT • UNITED STATES ARMY • UNITED KINGDOM GOVERNMENT



These are the wings that came in on a prayer. They are back in service now—ahead of schedule—after complete reconditioning in the shops of Fletcher Aircraft. This is veteran service for the veterans of the U. S. Navy. Fletcher Aircraft, with 8 years of progressive experience in aircraft fabrication, has adapted factory production techniques to the reconditioning of aircraft assemblies—and is getting the work out faster.

If you have a specialized problem in aircraft maintenance, rebuilding or repair, get in touch with—

Fletcher Aircraft
BURBANK, CALIFORNIA



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THE SCR-299 Mobile Radio Communications unit played a great part in the invasion of Africa and Sicily . . . these units were used as mobile radio stations, transmitting voice commands to fast moving armored units while in action, or as permanent radio stations . . . even under the most difficult operating conditions. A leading military authority said, "My observations in the theatres of war make it possible to say that the SCR-299 hit the jack pot in the mobile radio field as has the jeep in transportation."

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Winning the *"Battle of Production"* involves a lot more than a supremacy of materials, machinery and manpower. One major fire . . . or a small fire that results in crippling damage by the extinguishing medium . . . can halt or slow down war production in a dozen vital plants.

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By instant smothering of fire and cooling of combustibles through the mass discharge . . . at high rate of flow . . . of low pressure, low temperature CO_2, Cardox Systems provide the all-important advantage of fast, complete extinguishment of large or small fires—without damage by the extinguishing medium.

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- Timed discharges, as needed, through built-in piping systems . . . supplied instantly from a single storage unit holding tons (if required) of liquid Cardox CO_2.
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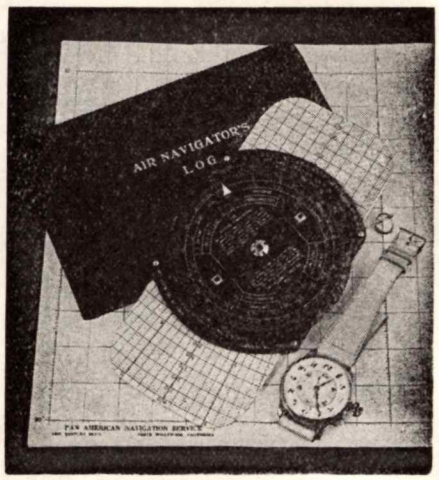

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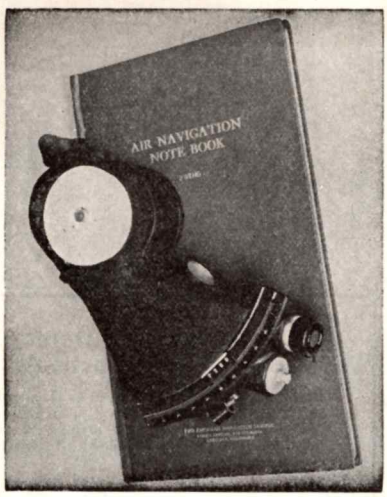

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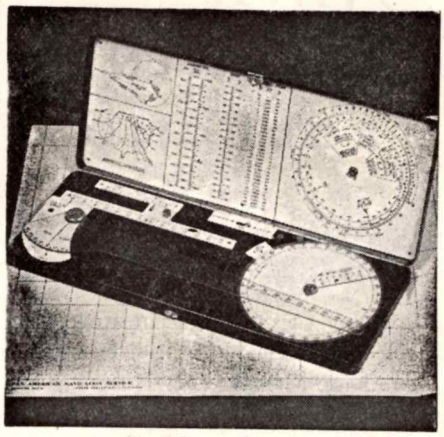

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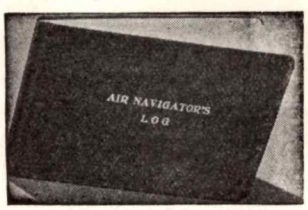


Something New—Air Navigator Log Book

At last . . . available to all airmen, is our new AIR NAVIGATION LOG BOOK. For the celestial air navigator on transoceanic flights—or for all pilots making "dead reckoning" flights across country, the "Navigator Log Book" will provide a permanent record of your navigational flights. Handsome blue leatherette (full pocket size) $2.00

Beginning September 9th, your Government will conduct the greatest drive for dollars from individuals in the history of the world—the 3rd War Loan.

This money, to finance the invasion phase of the war, must come in large part from individuals on payrolls.

Right here's where YOUR bond selling responsibilities DOUBLE!

For this extra money must be raised *in addition* to keeping the already established Pay Roll Allotment Plan steadily climbing. At the same time, every individual on Pay Roll Allotment must be urged to dig deep into his pocket to buy *extra* bonds, in order to play his full part in the 3rd War Loan.

Your now *doubled duties* call for these two steps:

1. If you are in charge of your Pay Roll Plan, check up on it at once—or see that whoever is in charge, does so. See that it is hitting on all cylinders—*and keep it climbing!* Sharply increased Pay Roll percentages are the best warranty of sufficient post war purchasing power to keep the nation's plants (*and yours*) busy.

2. In the 3rd War Loan, every individual on the Pay Roll Plan will be asked to put an *extra two weeks salary* into War Bonds—over and above his regular allotment. Appoint yourself as one of the salesmen—and see that this sales force has every opportunity to do a real selling job. The sale of these *extra* bonds cuts the inflationary gap and builds added post-war purchasing power.

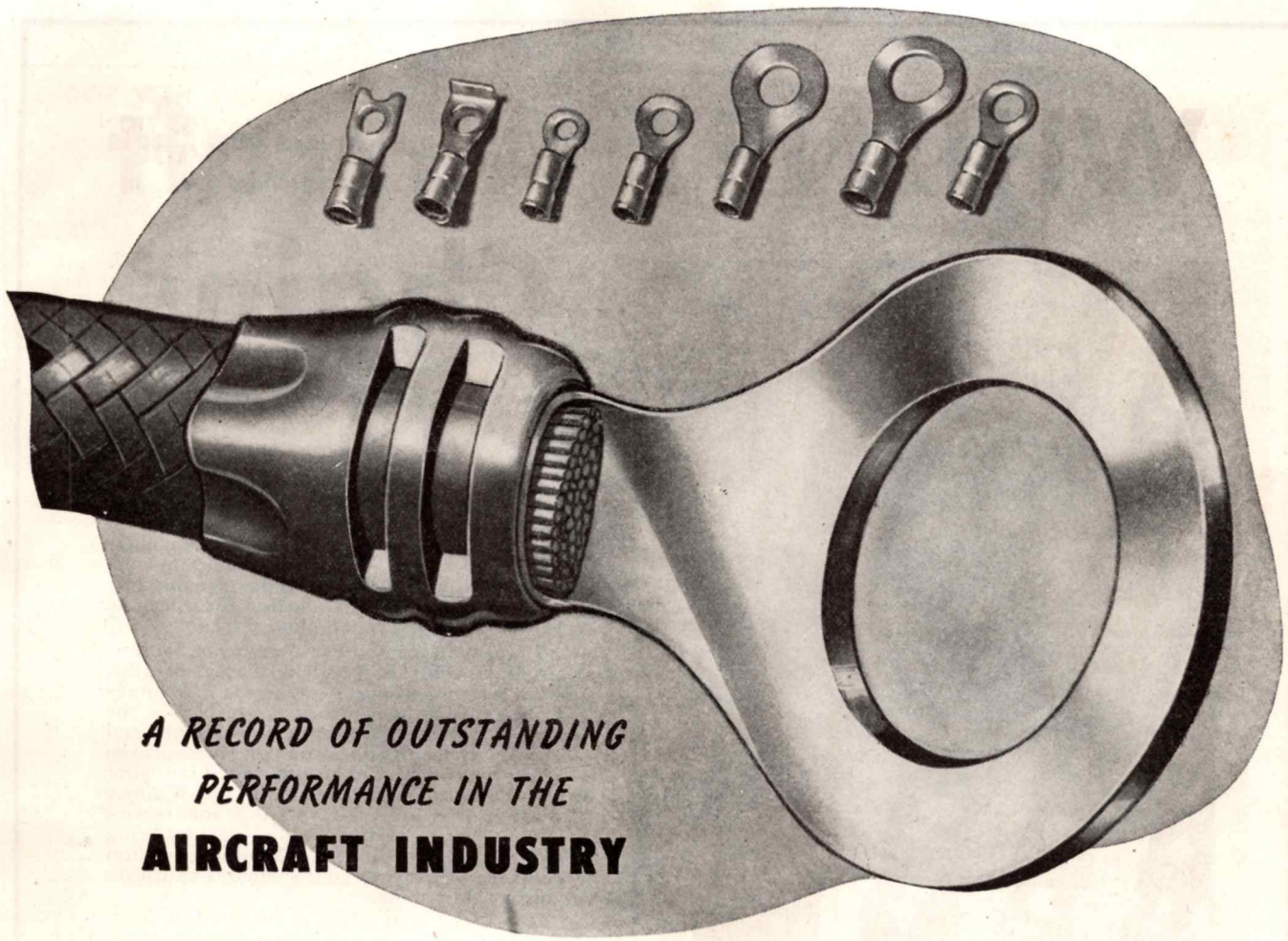
Financing this war is a tremendous task—but 130,000,000 Americans are going to see it through 100%! This is their own best *individual* opportunity to share in winning the war. The more frequently and more intelligently this sales story is told, the better the average citizen can be made to understand the wisdom of turning every available loose dollar into the finest and safest investment in the world—United States War Bonds.

★

★ ★

BACK THE ATTACK With War Bonds!

This space is a contribution to victory today and sound business tomorrow by **AERO DIGEST**



A RECORD OF OUTSTANDING PERFORMANCE IN THE

AIRCRAFT INDUSTRY

AMP "Diamond Grip" SOLDERLESS

Insulation Support Terminal

This pure copper solderless insulation support terminal is being specified in large quantities by the Aircraft industry because "Diamond Grip" is engineered for hundreds of varied applications where severe service conditions demand the use of a terminal giving superior mechanical and electrical characteristics — installed quickly and economically.

The patented design of the terminal gives maximum service efficiency of the crimped connection; "Diamond Grip" is approximately 1/32" shorter and 32% lighter in weight than other insulation terminals for the same wire sizes; the self-gauging precision-die hand, foot, and power installation tools are setting new production records even with untrained help . . . "Diamond Grip" is not just another solderless terminal — it is a scientifically engineered method of obtaining the highest quality connections. If you have not already investigated AMP "Diamond Grip," write today and we will gladly send you all the facts.

"Precision Engineering Applied to the end of a Wire"

AIRCRAFT-MARINE PRODUCTS INC.

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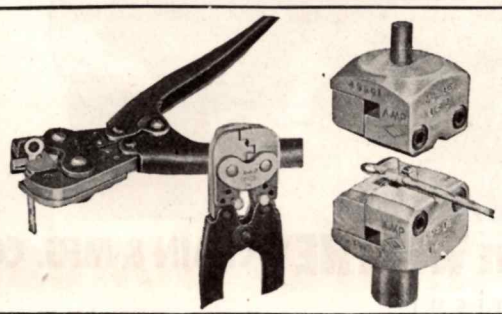
Canadian Rep.: A & M ACCESSORIES, LTD., 19 MELINDA ST., TORONTO, ONTARIO

AIRCRAFT-MARINE PRODUCTS INC. AMP SOLDERLESS WIRING DEVICES



THREE PERFECT CRIMPS AT ONE TIME

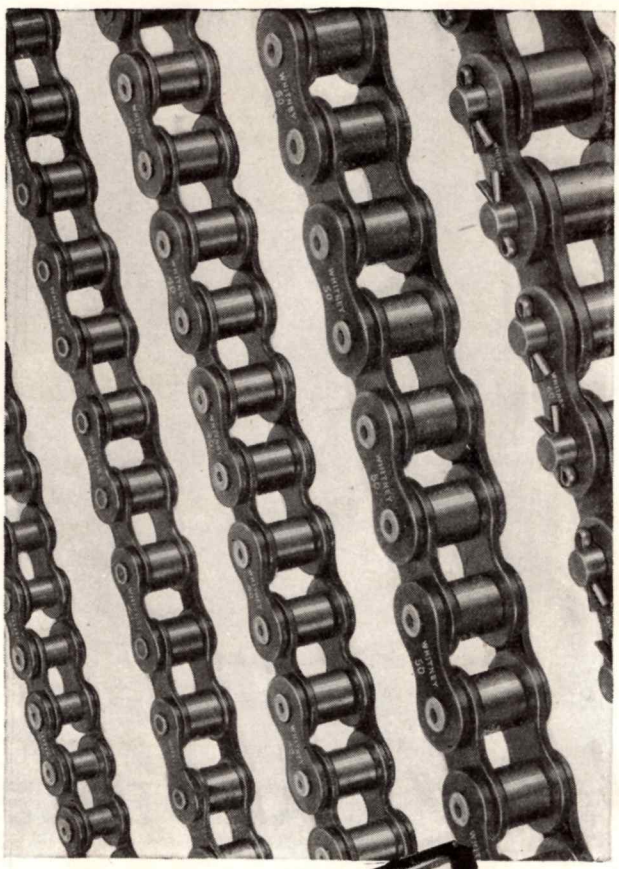
Diamond Grip Precision-die hand, foot and power operated installation tools materially reduce production time and assure uniformity of application without the necessity of worker pre-training. These self-gauging tools make three perfect crimps at one time —every installed terminal is the exact duplicate of all others in the line.

THE AMP SYSTEM OF SOLDERLESS WIRING

Unbiased laboratory tests of AMP Diamond Grip Terminals show no significant change in resistance even under the severest operating conditions, including a multiplicity of circuits, variations in current, voltage, temperatures and corrosion.

Write today for Bulletin No. 19.

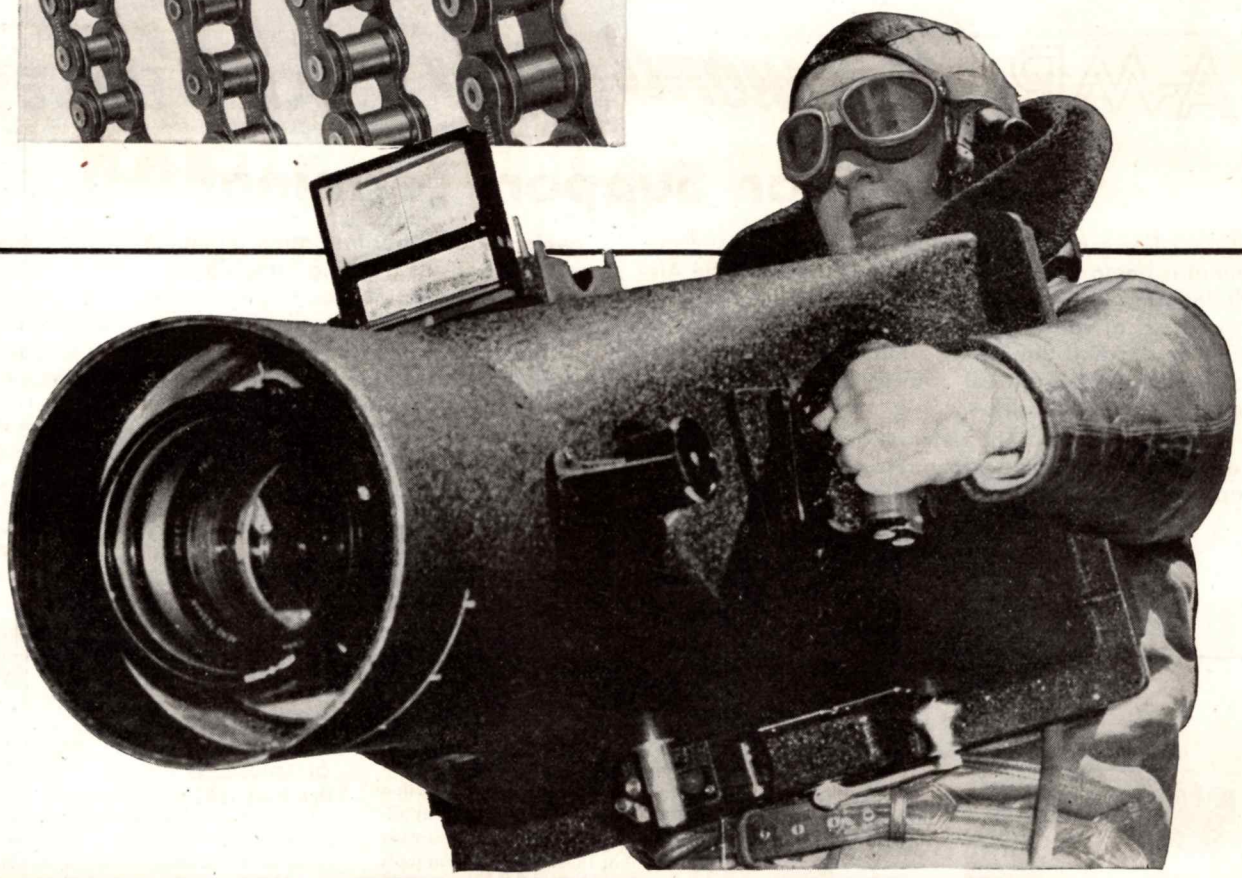
WHITNEY Aircraft Chains*



open the hatch for his camera

In the "silent shooting" of reconnaissance, mapping the targets for mass bombing assaults, Whitney Aircraft Chains also play their dependable part. When the photographer is ready to shoot, Whitney Chains act instantly and smoothly, at his command, to open the photographic hatch and close it again.

Here, as in many other aircraft mechanisms . . . flight controls, bomb displacement gear, aileron and elevator systems . . . Whitney Roller Chains and Sprockets are chosen for their compactness, flexibility, light weight, and unfailingly positive operation. And these proven Whitney products can be engineered into your own design-requirements . . . by the Whitney Aviation Division, which places at your service all of Whitney's engineering, manufacturing and technical resources. A Whitney Aviation engineer will answer your summons whenever you say. Just write.



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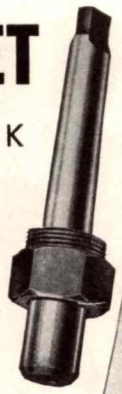
HARTFORD, CONNECTICUT

★ ERICKSON *Precision* COLLET CHUCKS

EVERY TYPE OF PRODUCTION WORK



Model
D 1

Two new models have been added to the well-known line of Erickson Chucks. These are "01" of greater accuracy and precision for general work and the "02," especially designed for Turret Lathes, Automatics and Screw Machines.

These three lines are available in a complete range of sizes and shanks to adapt them for all types of equipment. The new, complete, improved lines are the result of constant research and improvement by Erickson Engineers collaborating with prominent users throughout industry.

8-POINT COLLET GRIP

The Erickson Collet—open slotted at both ends—grips the tool shank (at 8 points instead of 3) permitting heavier feeds without vibration or loosening. Collet is capable of collapsing as much as 1/32" while maintaining its grip and accuracy.

SEND FOR BULLETIN "D"

Contains much valuable information on all types of production work.

★ **The ERICKSON COLLET REPLACES at Least 7 STANDARD SINGLE PURPOSE COLLETS**

★ *The Erickson Collet collapses at least 1/32" and maintains gripping power and accuracy.*

ERICKSON STEEL CO. 2309 HAMILTON AVENUE CLEVELAND, OHIO

AIR PILOT and TECHNICIAN
files a new 'flight plan'

● After fifteen years of service to its specialized field. The Sportsman Pilot emerges as AIR PILOT and TECHNICIAN. In its new form it will be a magazine better able to serve the ever-expanding group of men and women to whom flying is no longer a mystery, to whom flying now is the surest way to beat the enemy, and to whom flying will mean a better means of living when the war is won.

It is the intention and aim of the magazine's staff to make AIR PILOT and TECHNICIAN a publication which will be helpful and informative to this group of flying men and women. Their common problems and mutuality of interests will find expression in THE PILOT's pages.

With this broadened editorial policy we will be better equipped to serve all pilots—private, military, airline, and those engaged in other phases of civil and military flying.

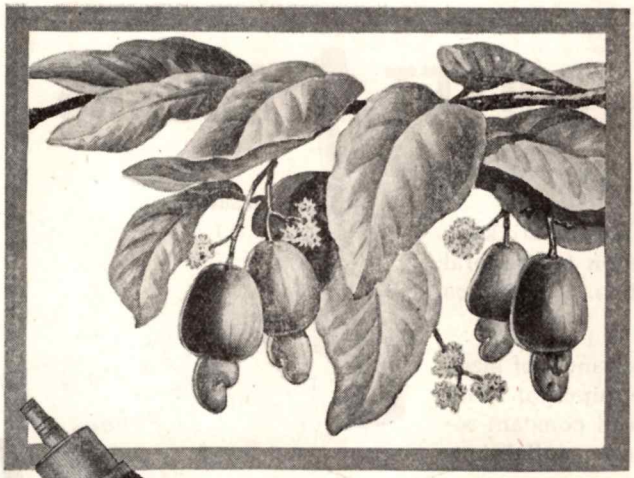
We look forward with unbounded enthusiasm to the task which lies ahead, confident that our newly chosen role will provide opportunity for usefulness even greater than our past contributions to flying.

Thus we file a new flight plan.

AIR PILOT and TECHNICIAN

(FORMERLY KNOWN AS THE SPORTSMAN PILOT)

515 MADISON AVENUE **NEW YORK 22, N. Y.**



This generator armature has been "Harvelized" by Hanson-Van Winkle-Munning Company.

THE SECRET OF BETTER INSULATION *in a* NUTSHELL

FROM the shell structure of the familiar Cashew nut comes a natural phenol which is the basic component of Harvel Insulating Varnishes. The discovery of this unique insulating ingredient which has been utilized by Irvington in the manufacture of a superior insulating varnish is the result of exhaustive research and an experience of over thirty-six years in making all types of insulating varnishes.

Harvel varnishes have many excellent insulating properties which add years to the life of motors, generators, transformers and other electrical equipment. They possess the highest safety factors even when operating under excessive heat, heavy over-loads and in atmospheres where acid or alkali fumes and abrasive materials are present. For example:

Motor failures in a large chemical plant occurred every three months until Harvel varnish was used. Now, three years of uninterrupted service on these same motors is not unusual. This is typical of Harvel performance under extreme conditions.

Harvel reduces the time necessary to produce a unit of electrical equipment by cutting the average baking time in half on applications involving multiple coats. It polymerizes to a solid infusible state and will not soften or "throw-out" at high peripheral speeds.

Harvel varnishes have excellent dip-tank stability—exceptional penetrating power—and contain no objectionable solvents.

Because the unusual features of Harvel varnishes are not all disclosed by ordinary laboratory methods of testing, why not get these facts first-hand? We will gladly send you a generous sample for testing. See for yourself how Harvel varnishes are superior for use with any type of insulation for application on equipment wound with enameled Formex and Formvar coated wire, Fiberglas, Cotton, Asbestos and paper or enameled wire of all classes.

For further information and samples, or for technical assistance on unusual problems, write Dept. 116.

Irvington

VARNISH & INSULATOR CO.

IRVINGTON, NEW JERSEY, U. S. A.
PLANTS AT IRVINGTON, N. J. & HAMILTON, ONT., CAN.
Representatives in 20 Principal Cities

GEARED TO PRODUCE

Specialists in sheet metal work with all modern plant facilities. 100% loyal American employees insure that your job will get out on schedule. Now serving leading aircraft manufacturers.

REF AIRCRAFT
CORPORATION
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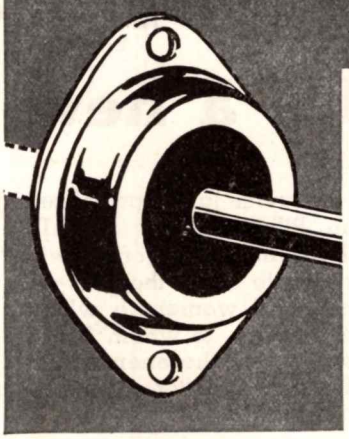
ARENS DURA-GROM
A NEW LIFETIME GROMMET



Support for control casings, oil and hydraulic lines, electrical cables, tubing, etc., through a firewall or bulkhead. Absorbs vibration and holds lines securely. Dura-Grom consists of two parts, oil resisting synthetic rubber disc and cadmium plated steel cup. Available in various sizes. Write for specifications today on business letterhead.

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PACKING MEMBER absorbs vibration, shock and holds line in a synthetic rubber cushion. It is held snugly against wall by metal cup retainer.

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REVOLVATOR PORTABLE ELEVATORS

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RED GIANT LIFTRUCKS

Plan NOW for tomorrow's keen competition as well as today's needs by installing these modern machines in your plant so that you can move, lift, pile or stack material more economically and efficiently. There's a type of each to fit your specific needs.

Our Elevators and Liftrucks are equipped with many features not found on other machines.

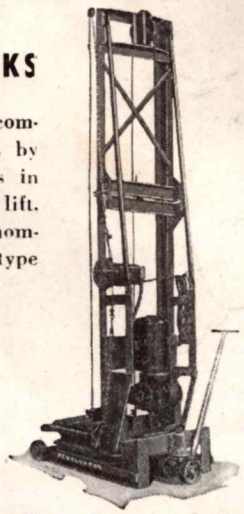

Photo shows standard REVOLVATOR with Combination Motor and Herringbone-Worm Gear Drive.

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DESIGNERS AND MANUFACTURERS OF MATERIAL HANDLING EQUIPMENT

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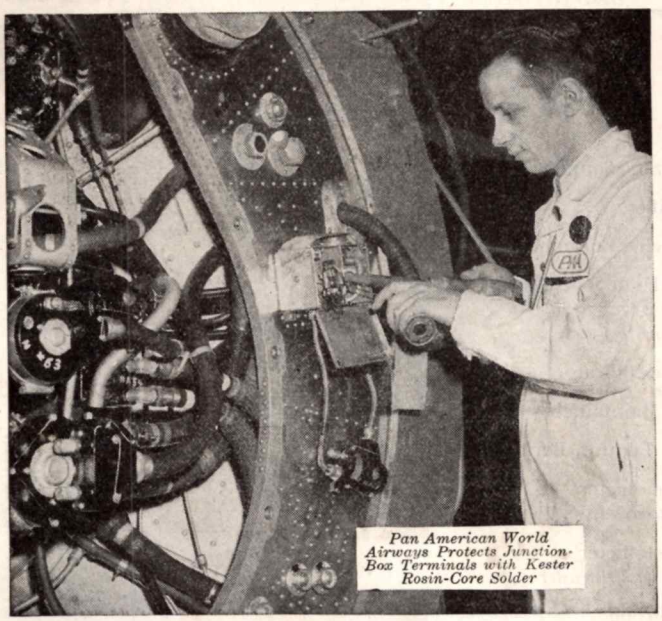
GONE—One Gremlin



Pan American World Airways Protects Junction-Box Terminals with Kester Rosin-Core Solder

Vital Contacts Made Tight and Permanent with KESTER SOLDER

- At Pan American World Airways bases, where the Clippers are groomed for their globe-circling hops—where precision and certainty in every operation are an inflexible rule—Kester Cored Solders are serving dependably to help insure efficient, trouble-free operation.
- Kester Rosin-Core Solder, in electrical systems, protects circuits from terminal resistance; the patented plastic rosin flux does not deteriorate, won't cause corrosion or injure insulating material.
- In general use, Kester Acid-Core Solder makes a tight, clean, permanent union. Like all Kester Cored Solders, it expedites production. Both flux and solder are applied in one sure, simple operation.
- All Kester Cored Solders hold tight! They stand up under bending, shock, vibration, and the contraction and expansion of temperature extremes from the Arctic to the Tropics.
- Kester engineers will gladly assist you in selecting the proper combination of alloy, flux and strand- and core-size to fit exactly any soldering requirement in your production. Consult them freely, without obligation.

KESTER SOLDER COMPANY
4221 Wrightwood Avenue, Chicago, Illinois
Eastern Plant: Newark, N. J.
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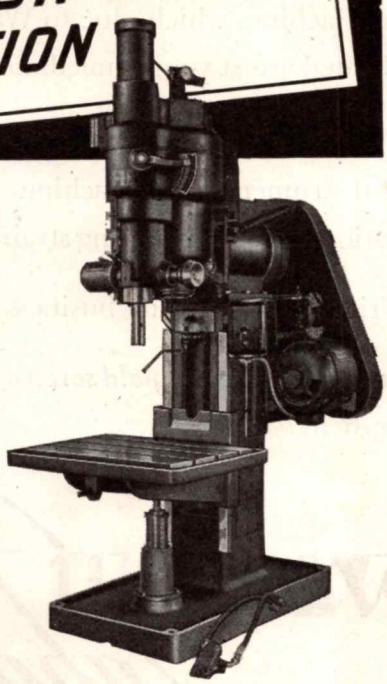
SILVER-LEAD ALLOY—Kester is prepared to offer for test on your work, a wartime solder of silver and lead, in cored and wired form.

KESTER
Cored Solders
STANDARD FOR INDUSTRY

For CONTINUOUS HIGH DUTY PRODUCTION



KAUFMAN No. 10 A Hi-Duty single spindle Lead Screw Tapper, made in 3 HP and 1½ HP models, with ¾" N.C. and 1½" N.C. threads in alloy steel offers these features:

Fully enclosed . . . lead screw and nut operate constantly in oil bath . . . positively wear-proof clutches instantly engaged and controlled by air cylinder . . . quick traverse when not actually cutting threads . . . accurate depth control . . . control to protect tap overload, and further protected against jamming if work is placed in upside down . . . class 3 fits always assured and perfectly controllable. *Complete information upon request.*

L. J. KAUFMAN MFG. CO.
MANITOWOC, WISCONSIN

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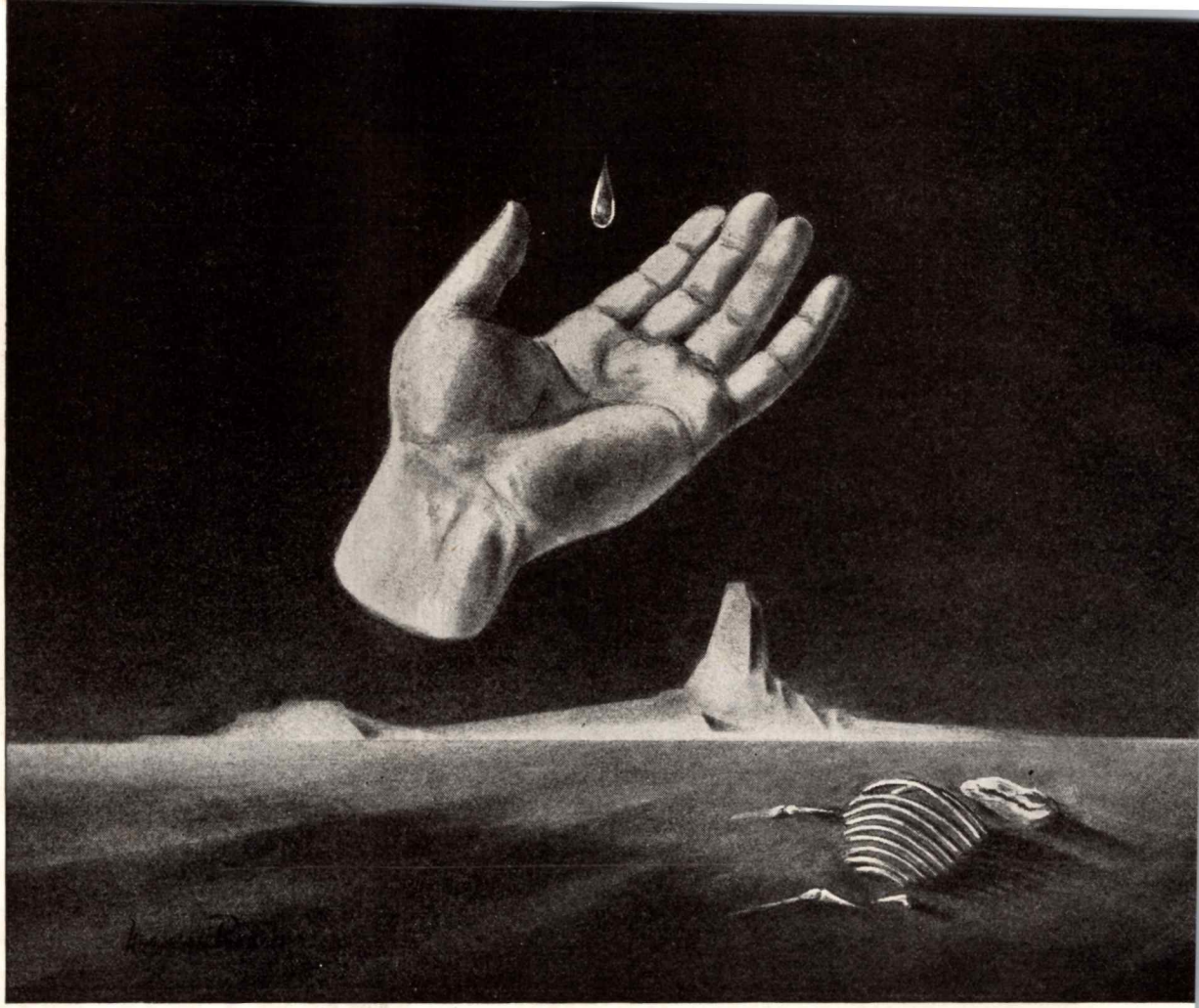


THE IRREPLACEABLE IS PRICELESS

RENTAL LIST

Waugh Laboratories INSTRUMENTS RENTAL LIST provides complete information regarding instruments, machines and equipments that are for rent, rates, and conditions of rental.

Our service manual describes these various instruments and their applications in detail.

Write for RENTAL LIST and service manual . . .

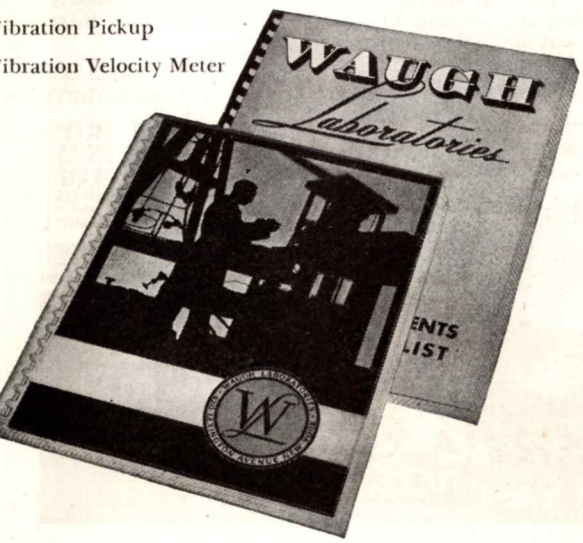
"ENGINEERING THINGS TO COME"

. . . yet at Waugh Laboratories, many instruments, irreplaceable for months to come, are promptly available on a *rental* basis. Machines which, due to War conditions, cannot now be duplicated are at your immediate service on telegraphic order.

Waugh Laboratories RENTAL LIST of more than *one hundred* instruments, and machines, for *inducing* and *measuring* vibrations and for analyzing strains and stresses sent on request.

Write today on your business letterhead.

Waugh Laboratories field service, if desired, also is available on a per diem *basis.*



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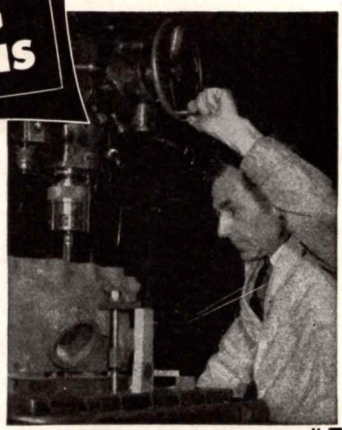

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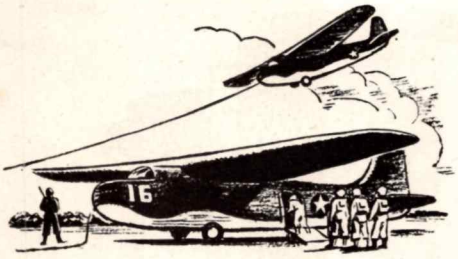

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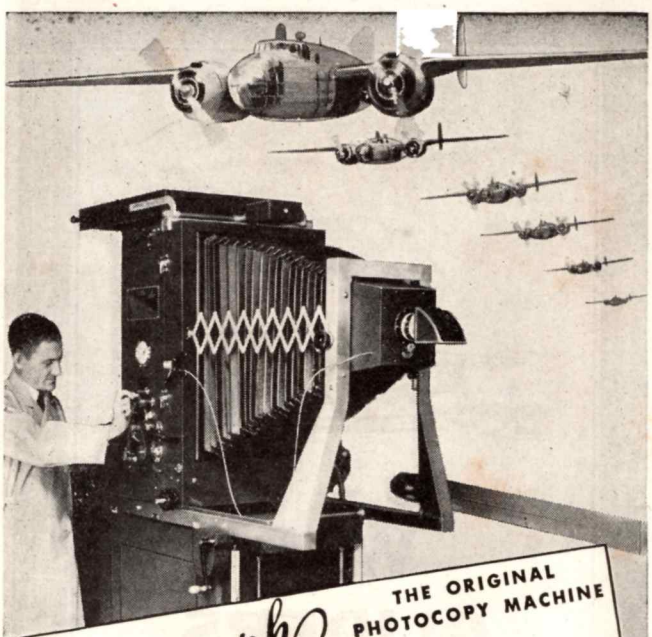

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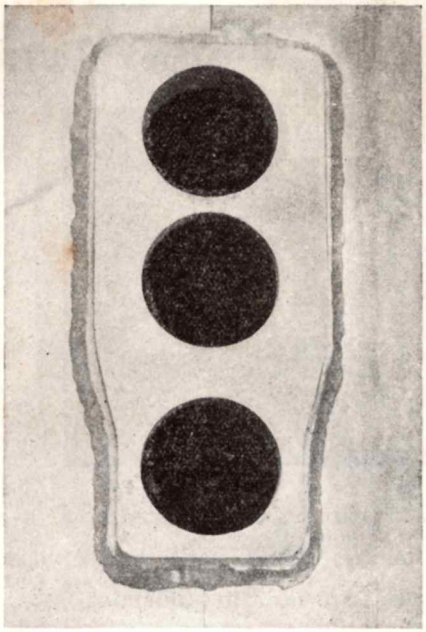

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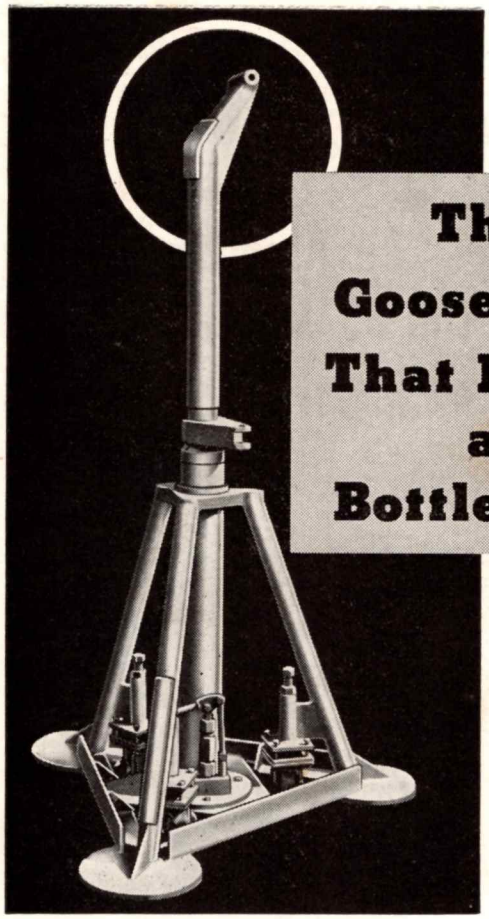

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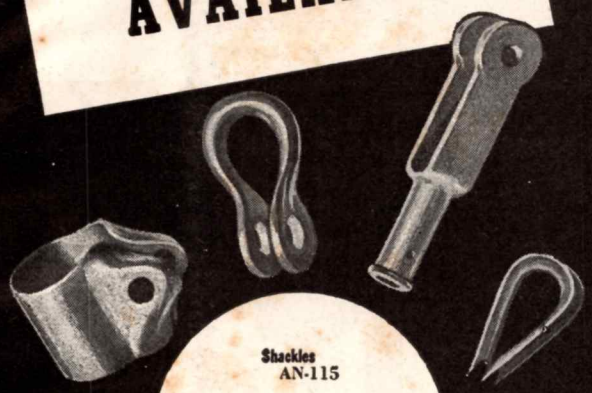

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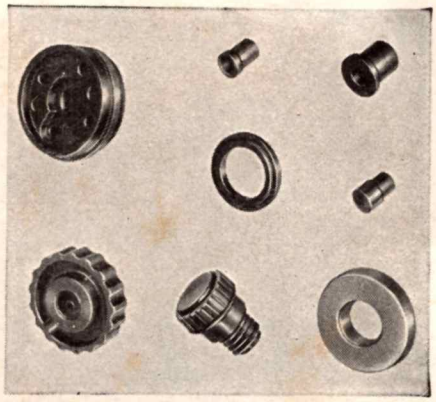

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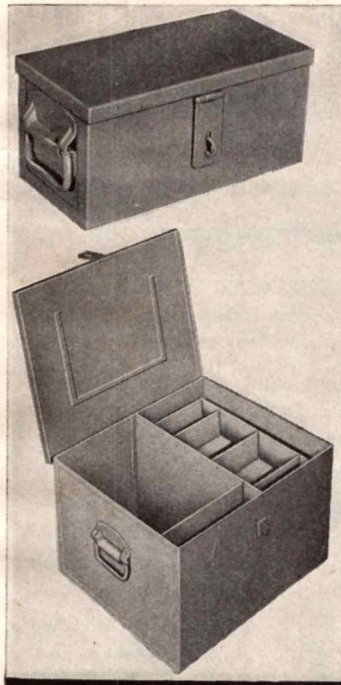

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Number	Length	Width	Height
1025- 1	12	6	6
1025- 2	12	9	6
1025- 3	12	12	6
1025- 4	12	9	9
1025- 5	18	9	6
1025- 6	18	9	9
1025- 7	18	12	9
1025- 8	18	6	6
1025- 9	18	15	9
1025-10	18	12	6
1025-11	18	15	12
1025-12	18	12	12
1025-13	18	18	12
1025-14	30	15	12
1025-15	24	15	12
1025-16	24	15	15
1015-17	24	18	12
1025-18	24	18	15
1025-19	24	18	18
1025-20	24	12	9
1025-21	42	9	9
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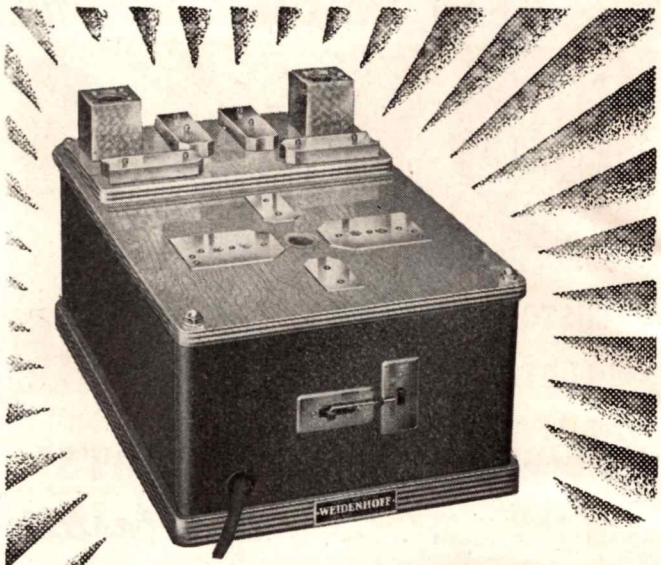

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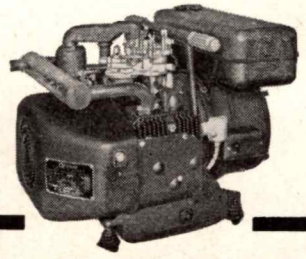

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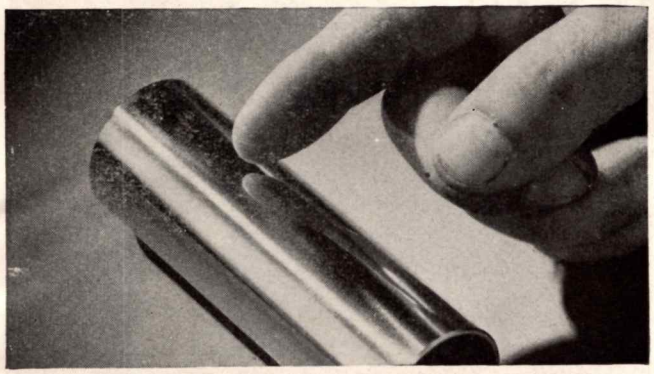

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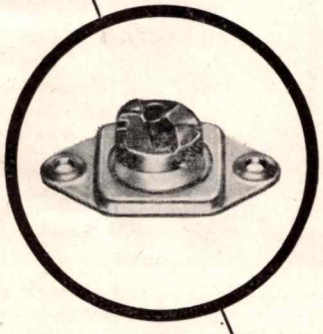

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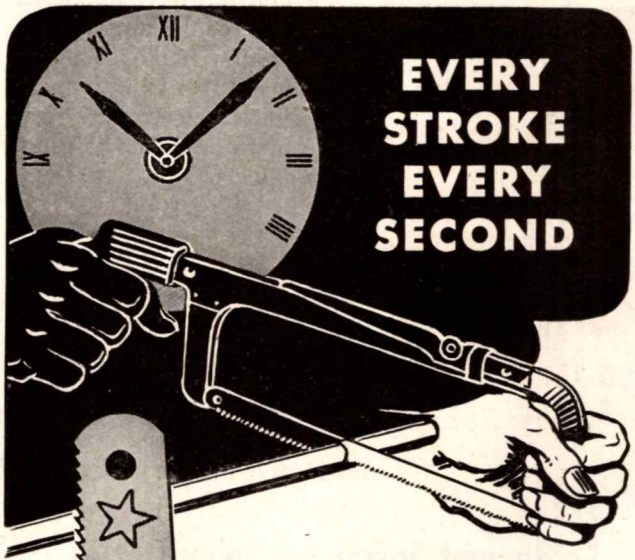

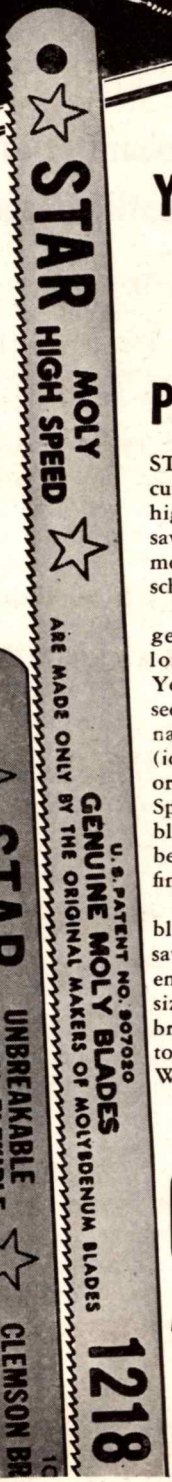

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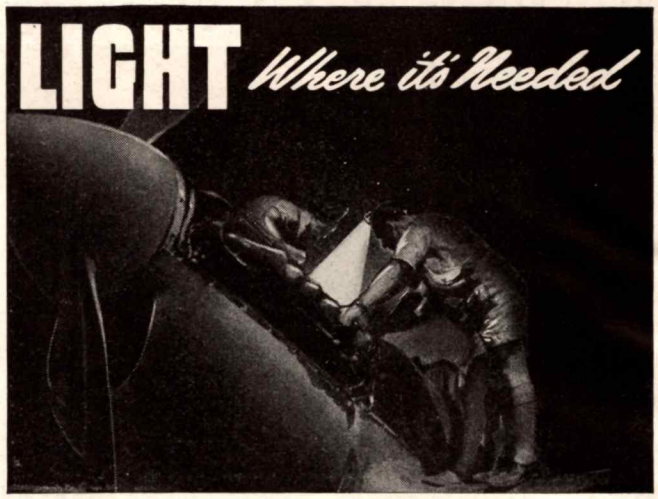
*T. M. Reg. — Blades bearing the name "Moly" are made only by Clemson Bros., Inc. and affiliated companies.

Makers of STAR Hack Saw Blades, Frames, Band Saws, and Clemson D-17 Lawn Machines



JUSTRITE ELECTRIC LANTERNS

★ In training camps and fighting fronts, Justrite Electric Lanterns are serving our armed forces. Yet here at home, their services are just as important to our war effort.

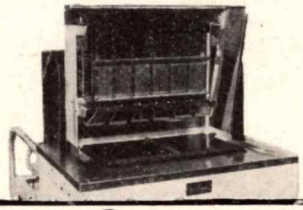
There are special models for factories, hangars, loading docks, railroads, oil wells and marine use. Also, Blackout Lanterns, Inspector's Lanterns, Emergency Lanterns and Headlight Lanterns (in illustration). Whatever your needs, when you need light, think of Justrite.

Write today for catalog and prices.

JUSTRITE MANUFACTURING COMPANY
2072 N. Southport Avenue, Chicago, Illinois

DO SPLIT RIVETS cause a break in your production line . . . and increase your costs? Don't let them! Put in Sweden Freezer equipment now. The same fine equipment that has been used successfully at Boeing for many years. Scientifically designed for the heat and cold treatment of aluminum rivets—large and small. Temperature tolerance of Sweden Freezer equipment is within plus and minus 5 degrees. Elapsed time in quenching control is a matter of seconds from high temperatures to extreme sub-zero points for maximum corrosion resistance. These amazing specifications that formerly seemed impossible to attain, are now standard with Sweden Freezer equipment. Sweden Freezer offers a complete control program . . . has the facilities to design and construct equipment to fit your needs.

Sweden Freezer Cabinet for the complete control of heat and cold treating of aluminum rivets.



For full details write, wire or telephone SWEDEN FREEZER COMPANY, 1140 West 53rd, Seattle 7, Washington.

Manufacturers of Aluminum Alloy Heat Treating Equipment

Sweden Freezer Company

1140 WEST 53RD
SEATTLE 7
WASHINGTON

The Builders of SEA-MITE Marine Engines Offer These SUB-CONTRACT SERVICES

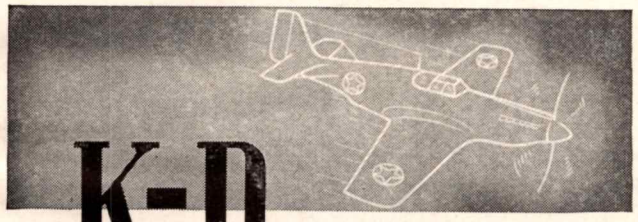
MACHINE WORK . . AUTOMATIC WORK . . ASSEMBLIES
CASTINGS . . FORGINGS . . WELDING . . BRAZING
HEAT TREATING . . ELECTROPLATING . . WOOD WORK, Etc.

Our Products Are Proving Their Worth on Sea, Land and In the Air

Write for New Booklet "Available Facilities for the War Program"

ARNOLT MOTOR COMPANY
WARSAW, INDIANA
ASSOCIATED WITH ATLAS STEEL & TUBE COMPANY

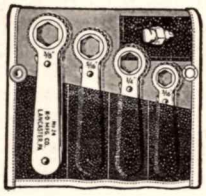
SEA-MITE *Marine Engine*



K-D TOOLS

For 24 years, K-D hand tools have been dependable friends to automotive mechanics everywhere. Whenever some hard job had to be "softened-up," K-D could be depended upon to produce the right tool for the job . . . and at a popular price. Some of these tools fit right into the aircraft industry.

No. 20 RATCHET WRENCH SET

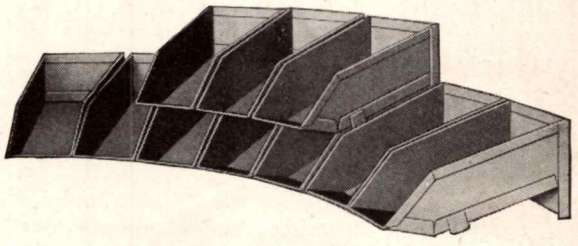


Openings 3/8", 7/16", 1/2" and 9/16", with offset screwdriver bit. Packed in fibre kit. Each wrench a complete tool with reversible ratchet, no heads to change or lose. Ratchet teeth close-spaced to permit short stroke in tight places. List Price $2.85.

If you have a special tool problem . . . and if it can be made by metal stamping, light forging or machining . . . contact K-D. We'll be glad to help if we can.

K-D Mfg. Co., Lancaster, Pa.

NEW BINS
for assembling small parts



Floors slope to feed parts to front—end reaching and fumbling.

Bins taper toward front to form convenient semi-circle—keep all bins within easy reach.

Nesting, locking construction for rigid set-ups, easily changed when necessary.

All-welded construction. Rolled, smooth edges.

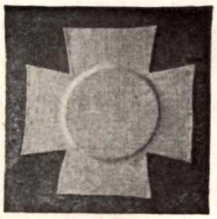
Two sizes—tapered or straight sides.

Hoppers available for steady work.

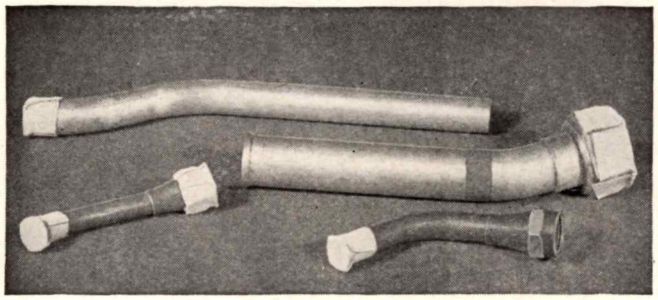
Write Stackbin Corporation, 79 Troy St., Providence, R. I., for further details and low prices.

STACKBIN SYSTEM
"Stacked and Still Accessible"
STACKBIN CORP., Providence, R. I.

ARNO
TUBE SEAL
No. 700



Pat. Pend.



A new, quicker, more reliable method for sealing all sizes of tubing. Made to engineered patterns with fiber disc and special quality adhesive. Easy and quick to apply. Can be removed in an instant, no residue.

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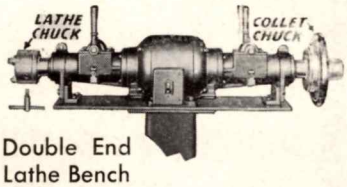
ARNO ADHESIVE TAPES, Inc.
MICHIGAN CITY, INDIANA

STANDARD
Speed Lathes
DESIGNED FOR SERVICE IN AERONAUTICAL PLANTS

Polishing, countersinking, reaming, lapping, burring, filing, etc., of small parts. In any speed from 150 R.P.M. to 3450 R.P.M. Lower speeds to order. OPTIONAL: Morse taper socket, drill chuck, lathe chuck or collet chuck. Sizes ½, 1, 1½, 2, 3, and 5 H.P. Write for catalog No. 43, prices specify voltage, phase, cycles, speed, and equipment desired.

Single End Lathe.

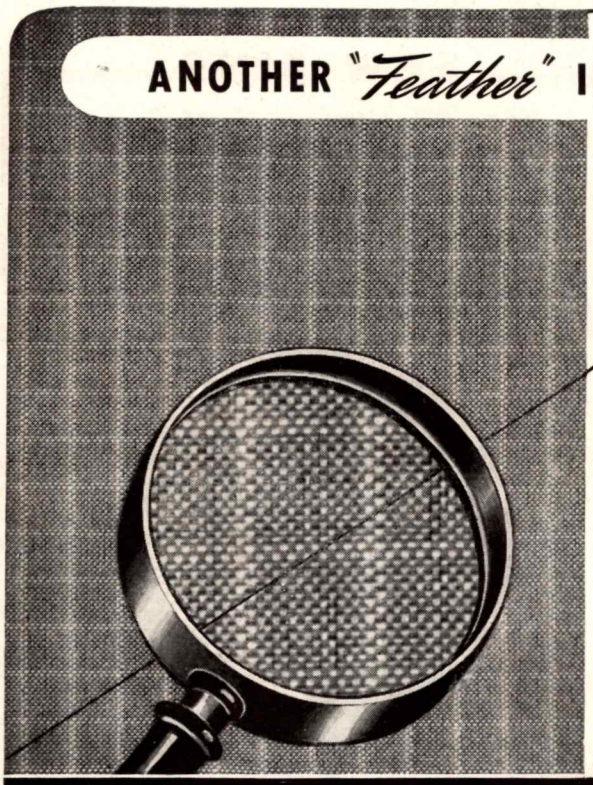


Double End Lathe Bench Model with Hand Control.

Bench Model with Foot Pedal.

Write for Catalog No. 43

The STANDARD ELECTRICAL TOOL Co.
CINCINNATI • OHIO
2494-95 RIVER ROAD



ANOTHER "*Feather*" IN THE PIONEER PARACHUTE PACK

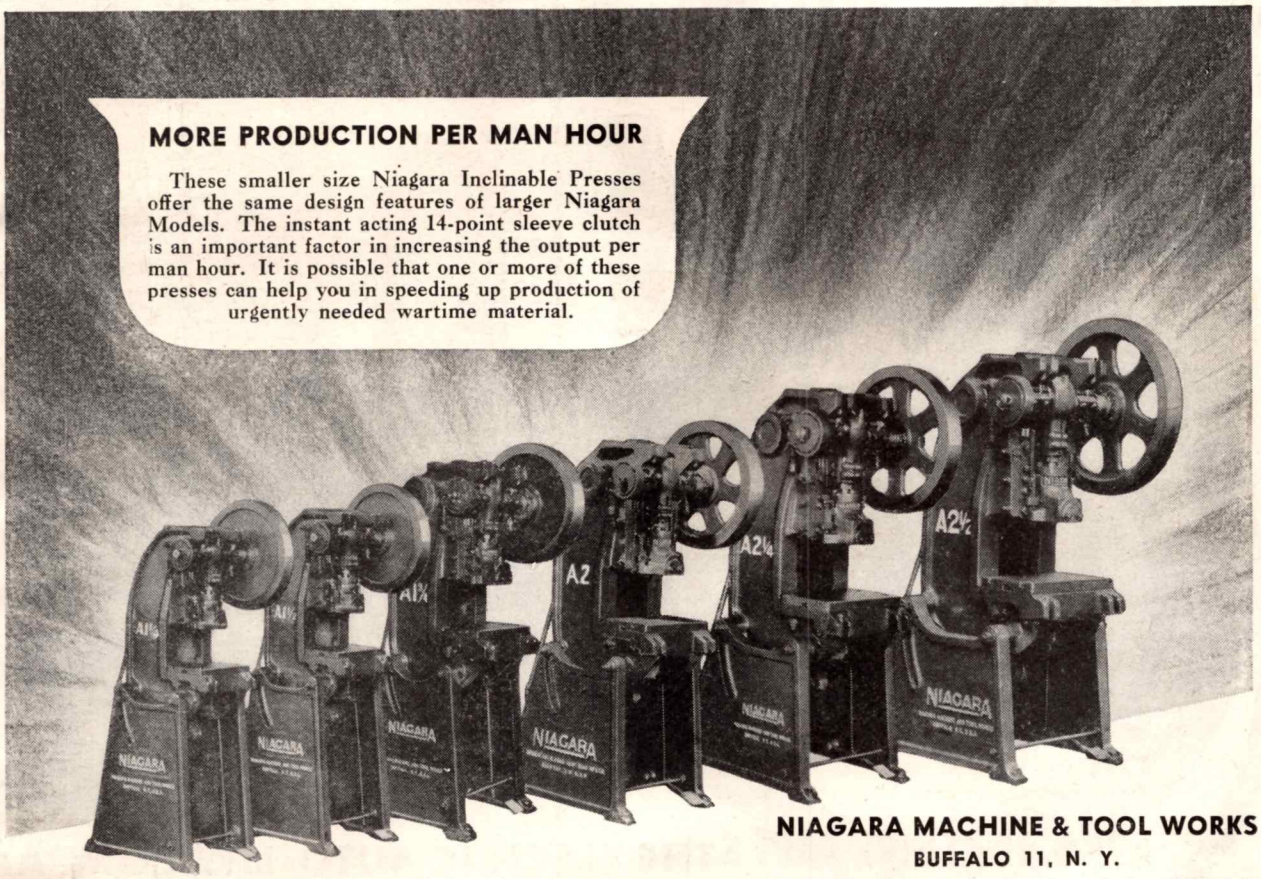
The New NYLON
Feather-Weight Fabric

THINNER • LIGHTER • STRONGER THAN SILK

Ceaseless experiments . . . never ending research by Cheney brothers, famous fabric weavers and Pioneer Parachute Engineers . . . and finally just the right weave — that's the way Pioneer Parachute Nylon "Feather-Weight" Fabric was born. Now that it's here, this fabric is destined to play a leading part in the manufacture of better and lighter chutes.

Pioneer Parachutes, already 25% lighter and occupying 50% less seating space than ordinary chutes, now through the use of new Nylon "Feather-Weight" Fabric, become even more compact, thinner and lighter than ever. It is another achievement in Pioneer Parachute development.

PIONEER PARACHUTE COMPANY, INC.
MANCHESTER, CONNECTICUT, U. S. A.
CABLE ADDRESS: PIPAR, TELEPHONE: Manchester 4157



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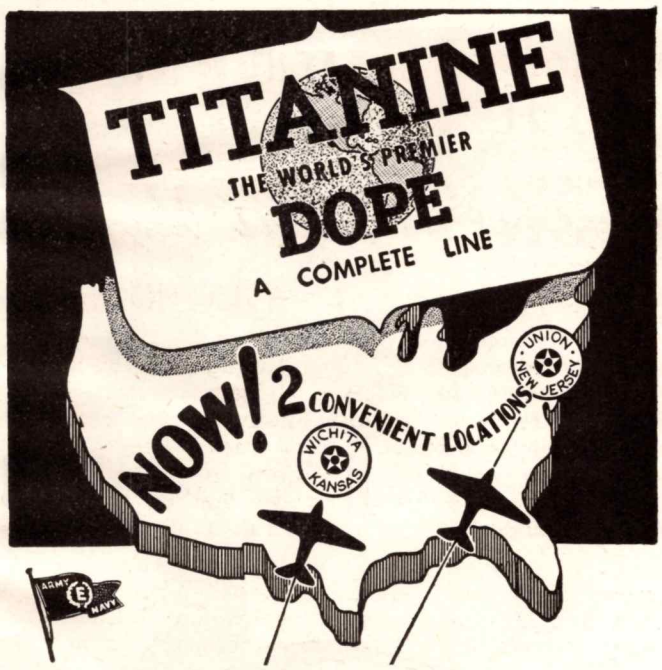

FINISHES FOR METAL, PLYWOOD OR FABRIC. CLEAR AND PIGMENTED DOPES. NITRATE OR ACETATE BUTYRATE.
ADHESIVES • PRIMERS • SURFACERS • ENAMELS

TITANINE, INC.
UNION • UNION COUNTY • NEW JERSEY
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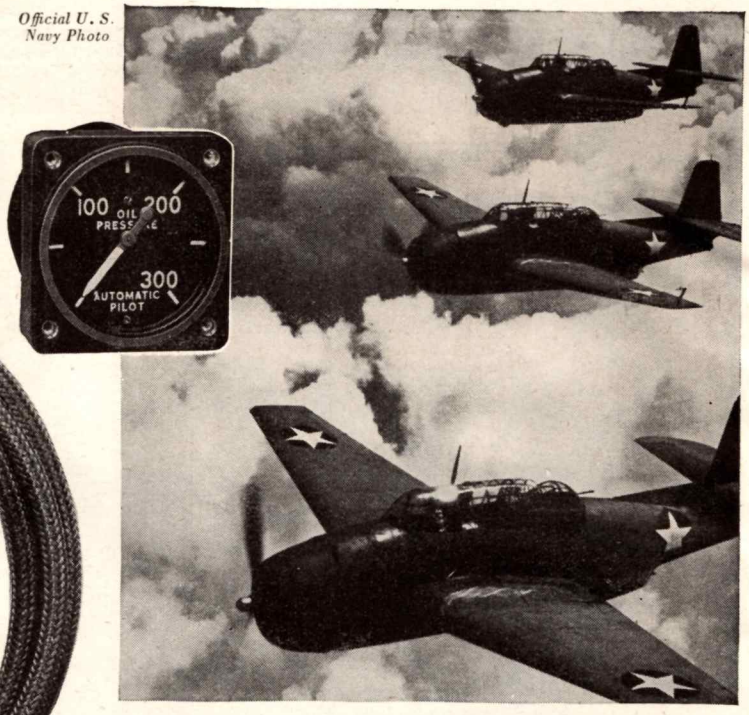
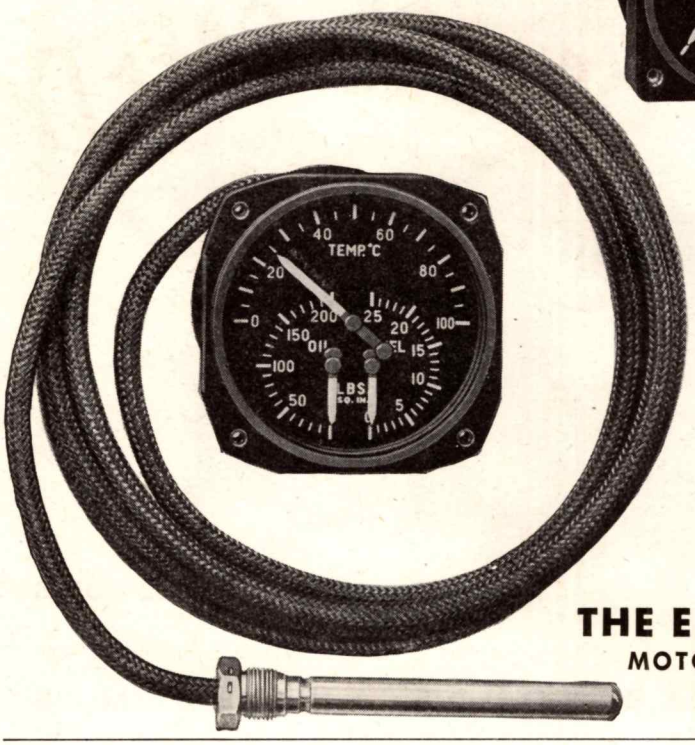
When FIGURES must be FACTS

Airmen rely on the precise performance of MOTO METER dial-type thermometers and precision gauges.

Official U. S. Navy Photo





MOTO METER products in war service include:

ENGINE GAUGE UNITS • CARBURETOR THERMOMETERS • FUEL PRESSURE GAUGES • AIR PRESSURE GAUGES • DUAL PRESSURE GAUGES • LANDING GEAR GAUGES • OIL PRESSURE GAUGES • FREE AIR THERMOMETERS • COOLANT THERMOMETERS • OIL THERMOMETERS • DE-ICING PRESSURE GAUGES

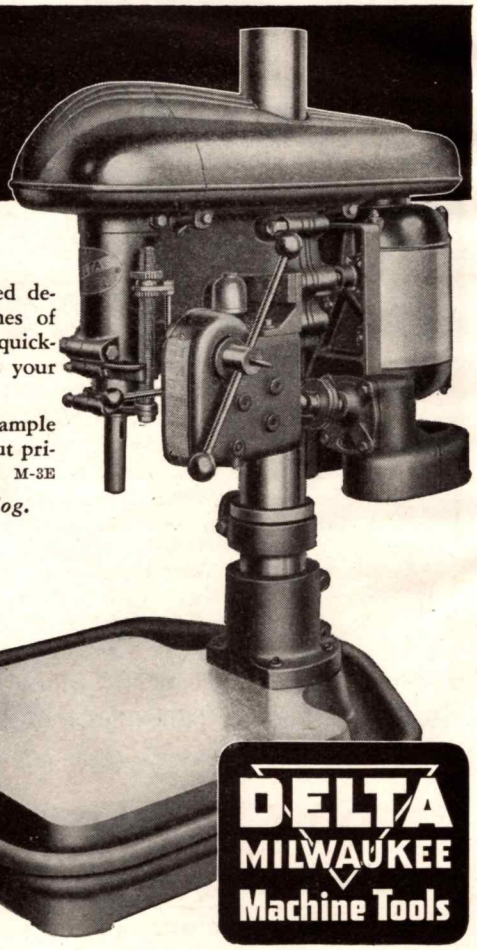
THE ELECTRIC AUTO-LITE COMPANY

MOTO METER GAUGE & EQUIPMENT DIVISION

CHRYSLER BUILDING, NEW YORK, N. Y.

Boost War Production

with your present labor force . . . by using DELTA POWER-FEED DRILL PRESSES



It doesn't cost a fortune or entail a long delay for retooling. Standard low-cost Deltas, used in hundreds of war plants, give quick relief from production "jams." Speedy operation saves time, power feed works automatically while operator loads another jig or works on another spindle — adding to output, cutting costs.

These are thoroughly engineered, substantially built, good-looking machines, made in a modern machine-tool plant. Advanced design combines best features of machines of this type. Safe, dependable, performance quickly pays for the machines and confirms your good judgment in installing them.

Your Delta distributor can show you ample evidence in your vicinity. Ask him about priorities and deliveries. M-3E

Mail the coupon for new Delta catalog.

DELTA FEATURES

1. Worm-driven power feed operates directly off motor — giving 8 *rates of feed for each spindle speed.*

2. One swift hand motion brings drill down to work—flip of power lever starts power feed.

3. Automatic stop holds depth of holes to close tolerances; spindle returns automatically.

4. *Instant* switching from heavy power-feed operations to sensitive hand drilling.

Tear out this coupon, mail today

THE DELTA MANUFACTURING CO.
634K E. Vienna Ave., Milwaukee 1, Wis.

Please send me your new catalog giving full details on Delta Power-Feed Drill Presses and your full line of low-cost machine tools.

Name_____ Position_____

Company_____

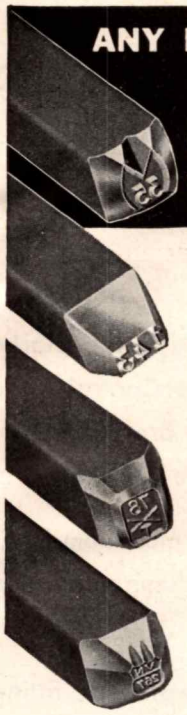
Address_____

City_____ State_____

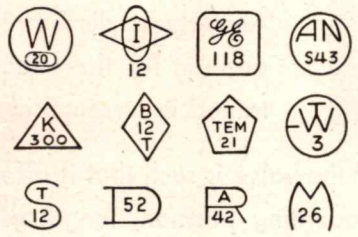
With one-piece tables: Floor and bench types, single spindle; floor type, 2- and 4-spindle. With sectional tables: Floor type, 3-, 4-, 5-, 6-, and 8-spindle. Slo-Speed or High-Speed No. 2 Morse Taper or ½" Jacobs Chuck spindle.

DELTA MILWAUKEE Machine Tools

ANY DESIGN OR LETTERING
*Reproduced in "Safe-Hed"**
STEEL STAMPS
*REG. U. S. PAT. OFF.



Matthews skilled craftsmen will accurately reproduce your trade mark . . . symbol . . . monogram . . . special lettering or design in sturdy built, "Safe-Hed" Steel Stamps . . . for inspection marking of your products or work identification stamping. Here are a few typical examples:



Write for Bulletin A-1

This valuable bulletin illustrates hundreds of stock symbols, and ideas for special designs for inspection or work identification stamping. Write for your free copy today.

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SPEED RANKS FIRST IN WARTIME CLEANING

How You Can Secure *BETTER* Paint Adherence on Aluminum

To prepare aluminum sheets and parts for painting, many plants prefer Oakite Compound No. 35. That is because their experience shows this specialized material definitely helps assure better paint adherence. It not only removes oil, grease and smut THOROUGHLY, SPEEDILY, SAFELY, but also produces a uniform microscopic etch that leaves degreased surfaces in prime condition for taking a firmly bonded paint coat. Further data FREE on request. Write today!

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Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE
Specialized
CLEANING

Buy Bonds for Victory

SYMBOL OF SAFETY

The name "IRVIN" on the harness means the chute is produced in an Irvin Factory with over 20 years of experience and skill in chute-making.

Literature can be had by school or training executives for the asking. Address Main Office, Buffalo, N. Y.

IRVING AIR CHUTE CO., INC.
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IRVIN *air chutes*
SERVING THE UNITED NATIONS' AIR FORCES

Clarke HYDRAULIC GUN TURRET CONTROL VALVES

AERO-HYDRAULICS, INC.

- *Smoothness of control*
- *Ease of adjustment*
- *A definite "feel"*

These qualities as found in the Clarke Aero-Hydraulic Gun Turret Control Valve account for the effective fire power obtained in turrets using the Clarke Valve.

The design of the valve is such that it affords maximum flexibility as to mounting position, length of column and style of grips.

This flexibility of design makes the valve susceptible to fitting a wide variety of turret installations.

CLARKE AERO-HYDRAULICS, INC.

PASADENA • CALIFORNIA

CLARKE AH AERO-HYDRAULICS

MOTORS

Small

FRACTIONAL HORSEPOWER

in following types

Shaded Pole — AC-DC — DC and Low Voltage

1/500 HP to 1/12 HP

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MENOMINEE, MICHIGAN

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SPEEDING THE DAY OF VICTORY

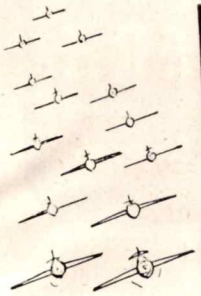
Revco

REFRIGERATED RIVET DISPENSER

REVCO Selective Automatic Rivet Dispenser is the last word in speeding production where rivets are used. Chilled rivets in 8 selections are dispensed in fiber cartridges. Condensation free and no spillage. Over-aged rivets are avoided, thus eliminating waste.

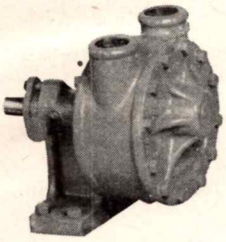
Write or phone for details.

REVCO, INC., Deerfield, Michigan



MASS DEMONSTRATION OF PRECISION

HUNDREDS OF THOUSANDS OF TUTHILL PUMPS IN SERVICE PROVE THEIR DEPENDABILITY



Tuthill Pumps are serving Army • Navy Air Force Merchant Marine

The importance of precision in pump manufacture is clearly shown by the long record of outstanding performance set by Tuthill Pumps. In every branch of industry, these positive displacement, internal-gear rotary pumps have demonstrated their built-in superiorities for coolant, lubrication, hydraulic, and liquid transfer service. Capacities range from 1 to 200 g.p.m. with pressures up to 400 p.s.i.

Write for complete Tuthill Catalog

TUTHILL PUMP COMPANY
939 EAST 95th STREET • CHICAGO, ILLINOIS

When the job calls for COLOR

Templar

Thin Lead

COLORED *Indelible* PENCILS

A wide range of vibrant colors — for a wide range of work. **TEMPLAR Colored Indelible enables artists, engineers, architects, draftsmen, and office workers to do a smooth, efficient day-long job without annoying breakage or stoppage. These extra-value features will speed up your work:**

- *Brilliant, satin-smooth colors that will not run, smear, or fade.*
- *Extra strong leads for long hours of pencil work.*
- *Long-lasting thin lead points for fine line work.*
- *Permanent, soluble colors for water coloring, painting, blueprinting.*
- *Finest cedar wood casings, colored to match leads for quick identification.*

In boxes of solid colors, or easel box of 12 assorted colors.

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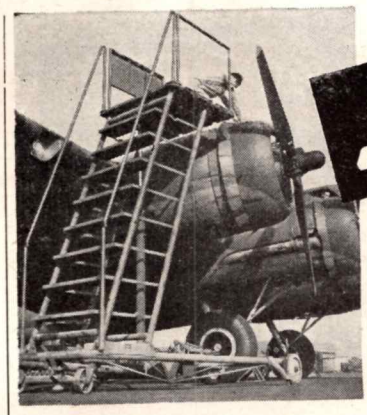
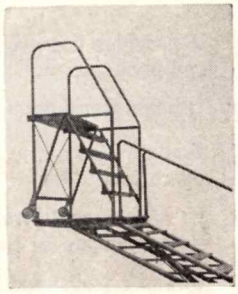


PECO EQUIPMENT

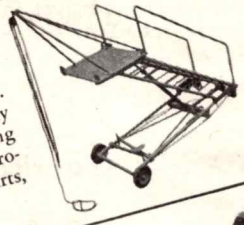
Speeds Servicing
Reduces Costs
Saves Man Hours

*Aerostand**

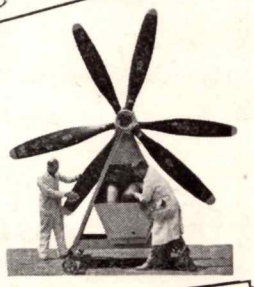
THESE husky, rigid workstands are mobile as dollies — enable workers to reach every part of plane quickly and work in safety. Model 10 (above) is adjustable 3′ to 10′ by hand-operated hydraulic strut. Made of light tubular steel—4′ x 4′ platform with 2′ extension—4′ x 11′ base with stabilizers. Capacity 1500 lbs. 16″ airwheels for towing; casters for hangar use. Aerostand "Senior" (No. 20 upper right) is adjustable to 20′ from 10′ base—rigid tubular steel mobile base. Aerostand "Junior" (No. 4, lower right) is 4′ high; caster equipped, and can be used alone or as extension on No. 10 or No. 20



HOIST ATTACHMENT
Lifting load, 1000 lbs. Can be used on any Aerostand. A traveling hoist for lifting propellers, motor parts, assemblies, etc.



Propstand

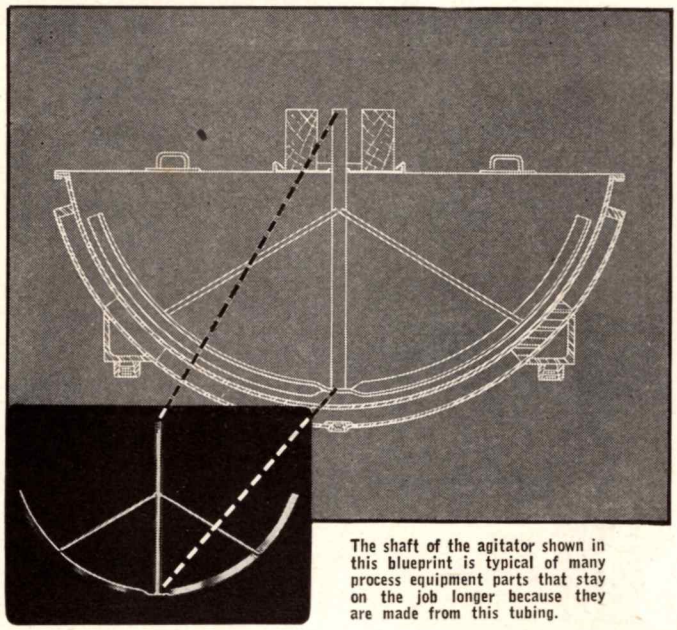


Caster-equipped, rigid propeller-holder with ample closed storage compartments for attachments. Carries 2 props.

Write for complete details of this service-speeding equipment.

**PACIFIC ENGINEERING CORPORATION*
3123 SAN FERNANDO ROAD
LOS ANGELES 41, CALIF.
DESIGNERS AND PRODUCERS OF SPECIAL EQUIPMENT

*Trade Mark Reg. U. S. Pat. Off. Pat. Applied For



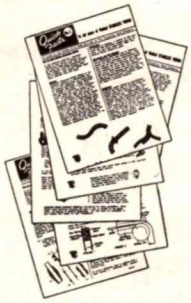
The shaft of the agitator shown in this blueprint is typical of many process equipment parts that stay on the job longer because they are made from this tubing.

Check these 5 Advantages of this Welded Stainless Tubing!

Here are five of the reasons why more and more Carpenter Welded Stainless Tubing is used in many types of processing equipment:

1. **It provides positive protection against corrosion and heat.**
2. **It helps guard against product contamination.**
3. **Easy to clean, this tubing saves time between operations.**
4. **Its high strength-weight ratio permits the use of lighter gauges for lower costs, less weight.**
5. **Uniform walls and lighter gauges mean easier bending, flanging, welding, etc.**

For help in selecting the type of Welded Stainless Tubing best suited to your needs, get in touch with our Metallurgical Department. Ever since Carpenter pioneered the development of this type of tubing, we have provided production-engineering assistance to users and fabricators.



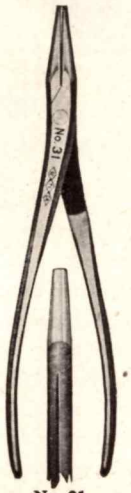
Fabricating Hints

in Carpenter's series of QUICK FACTS bulletins can help you get the most from Welded Stainless Tubing. A note on your company letterhead will start your series of QUICK FACTS bulletins on the way.

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division . . . Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING

UTICA PLIERS
FOR MORE TOOL HOURS



No. 31

UTICA Tools have got what it takes . . . time-saving design and the dependability of high quality workmanship and materials . . . to "keep 'em coming" on schedule. And UTICA is doing its best, with the help of its distributors, to fill essential orders.

•

No. 31—Duck Bill Wiring Pliers—7¾ in.

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UTICA DROP FORGE & TOOL CORP.
UTICA, NEW YORK

AIRCRAFT PLYWOOD

Available for Immediate Shipment

Large Stocks of Standard and Odd Sizes carried in our Chicago Warehouse for shipment same day order is received.
Made in accordance with AN-NN-P-511b specifications.
Stock List Furnished Upon Request. Orders requiring special manufacture will receive prompt attention.

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The Ward Leonard Rheostat shown on this International Blood Plasma Centrifuge was selected as the motor control because of its dependability, its many accurate steps, and its electrical interlock which assures a slow start irrespective of when the switch is closed.

Ward Leonard Rheostats are available in a wide range of sizes for single and multi-mounting, manual or motor drive. Send for bulletins describing these and other type rheostats.

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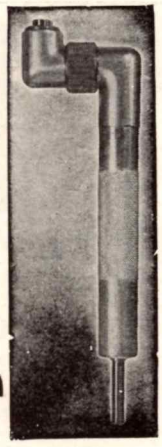
No matter how hard to reach an area may be, or how cramped the quarters, there's a Terry Angle Drilling Attachment to do the job quickly and efficiently. Terry tools are making outstanding contributions to aircraft production. Can be used with practically all types of portable electric and pneumatic drills. Several models, all precision built for severest usage. Request details on your Company letterhead.



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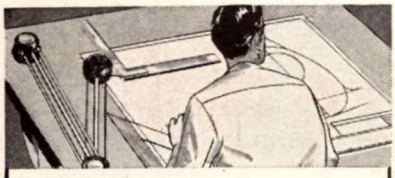
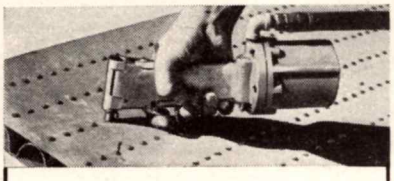
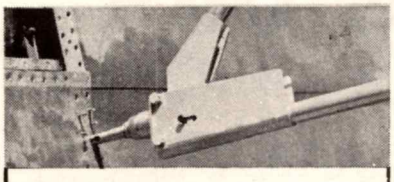
This mechanical BLIND RIVET helps all three



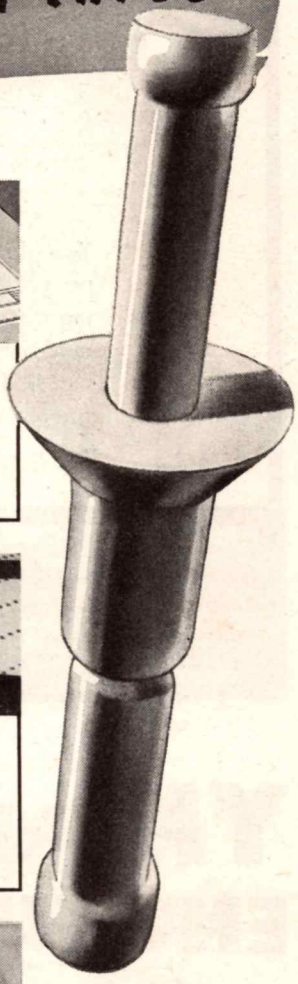
THE ENGINEER, by using Cherry Rivets, can disregard blind spots in riveted structures. He designs up to efficiency, rather than down to a manufacturing limitation.

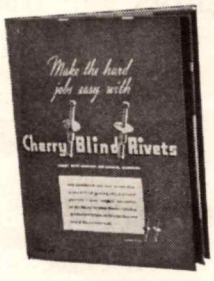


THE PRODUCTION MAN can increase output by using Cherry Rivets . . . gets a better job in blind or hard-to-get-at places. One man does the job. No bucking bar is needed.



THE SERVICE MAN does a better job in less time. Does not have to ream holes because Cherry Rivets work well with reasonable tolerance in grip length and hole size.





Get the complete story on Cherry Blind Rivets in the Handbook A-43. Request yours from Dept. A-103, Cherry Rivet Co., Los Angeles 13, Calif.

CHERRY RIVETS, THEIR MANUFACTURE AND APPLICATION ARE COVERED BY U. S. PATENTS ISSUED AND PENDING.

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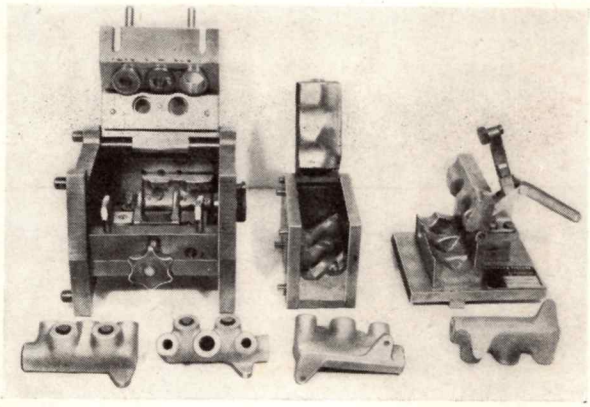

CERROMATRIX JIGS FOR

HYDRAULIC FITTINGS

Illustration shows (3) jigs for coordinated milling and drilling of rough aluminum castings. Cerromatrix is used in each jig to properly nest the part. Cerromatrix completely solves tough problems which exist in the machining of intricately shaped parts.

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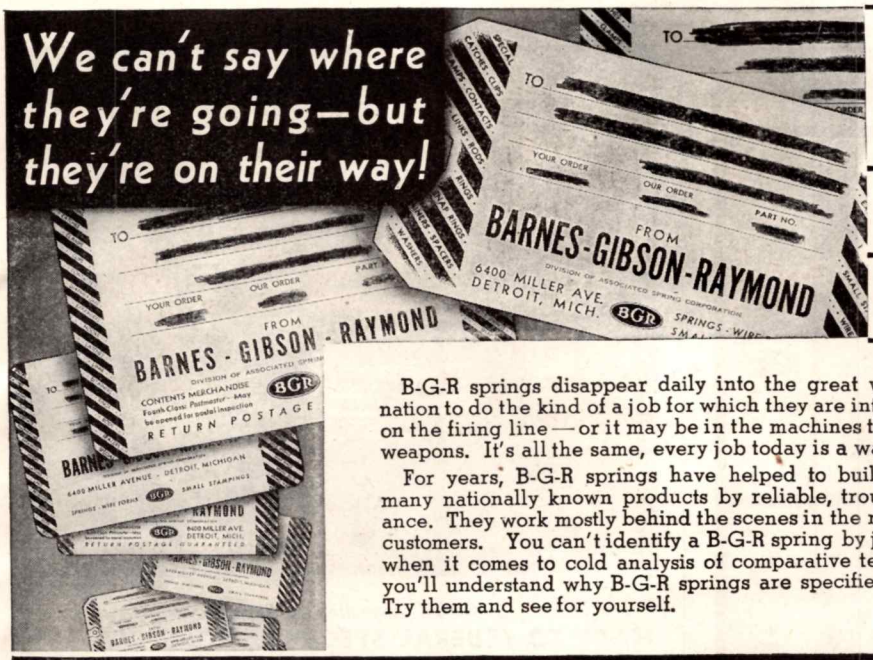

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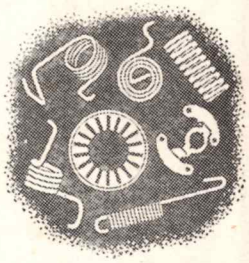

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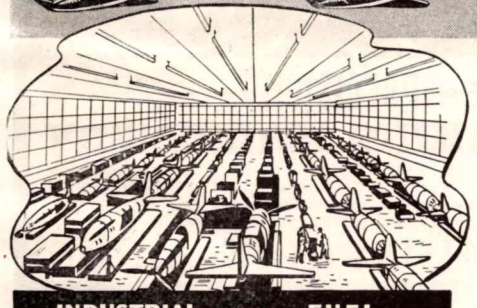

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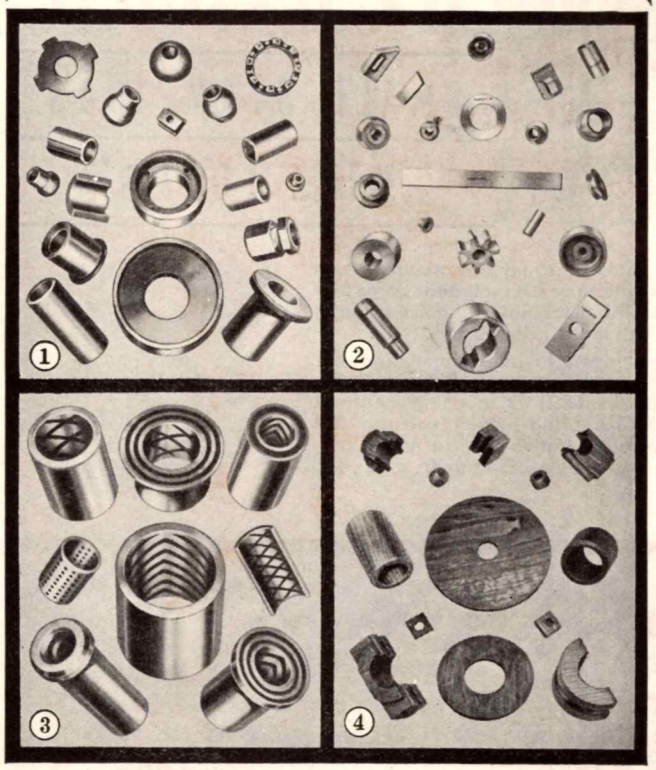

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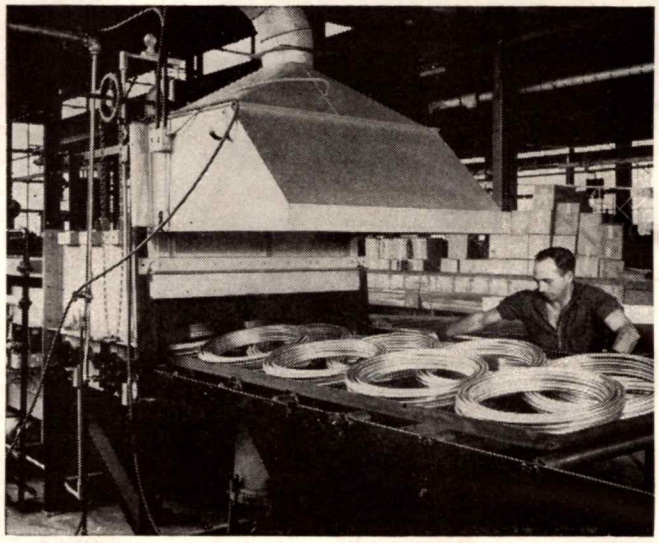

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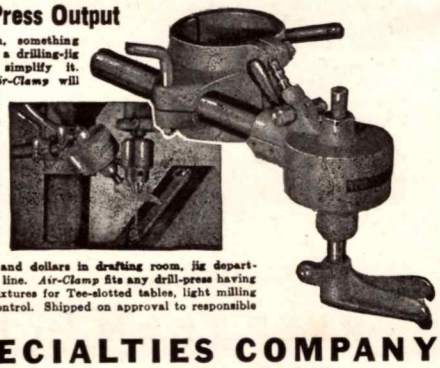

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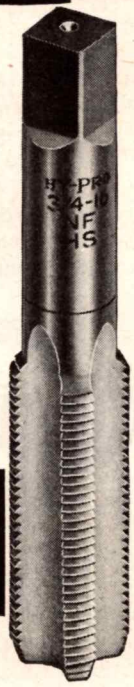

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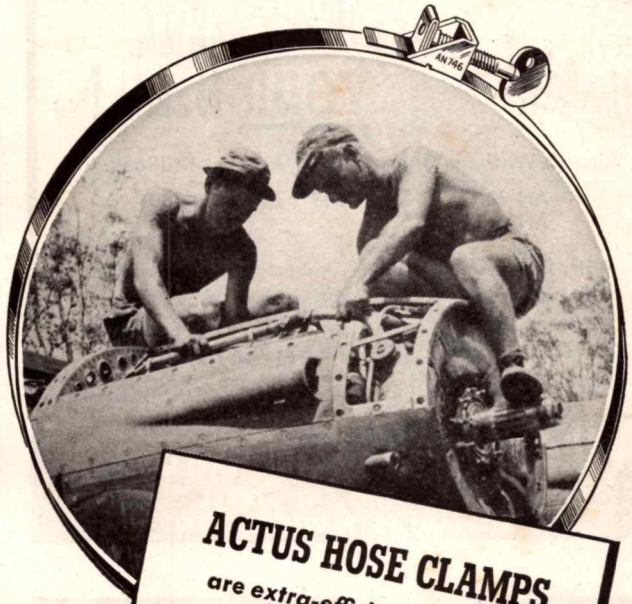

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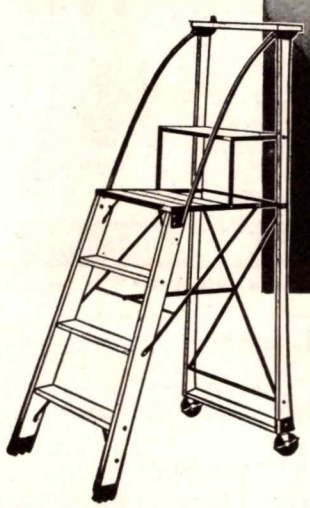

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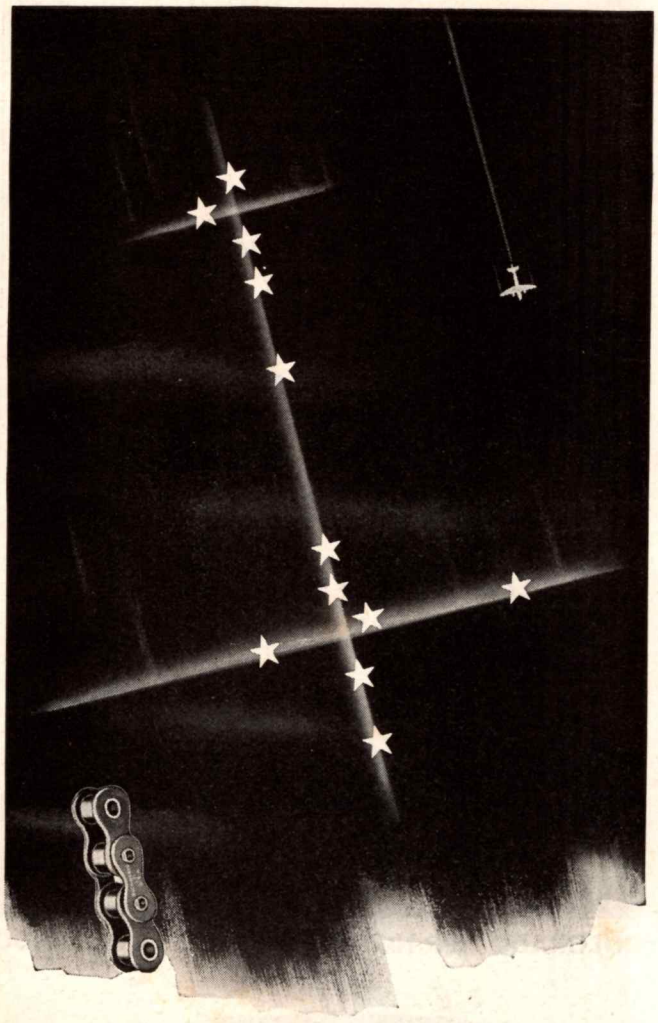

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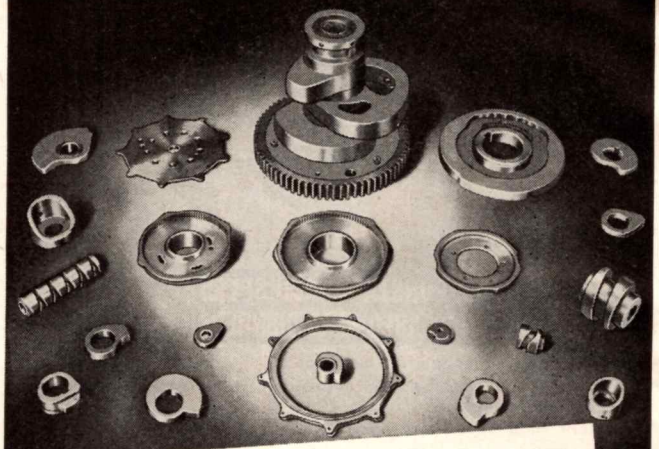

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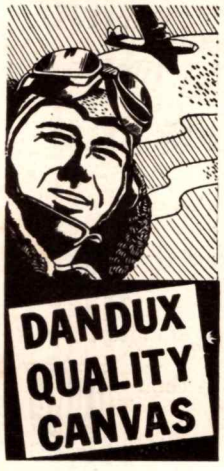

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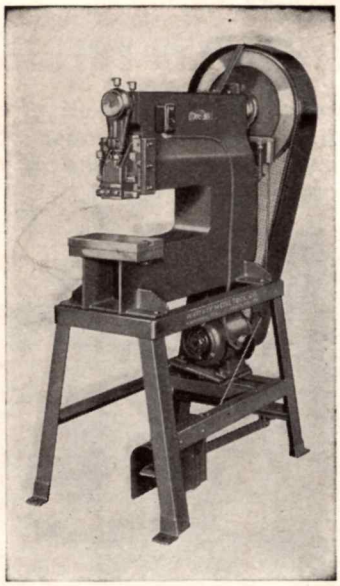

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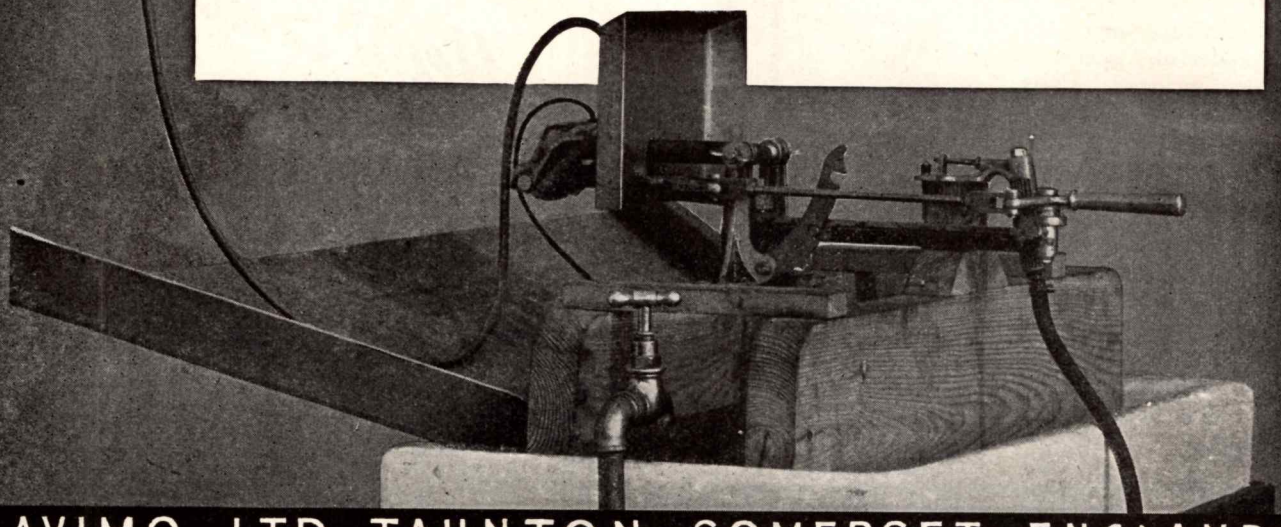

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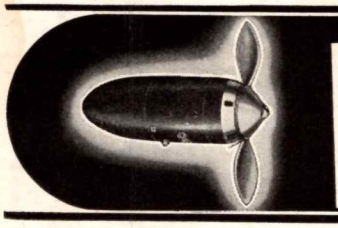

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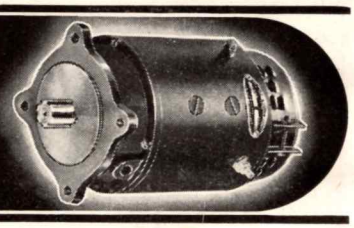

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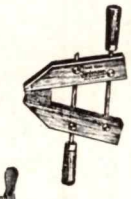

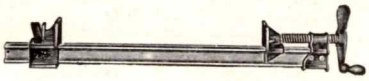

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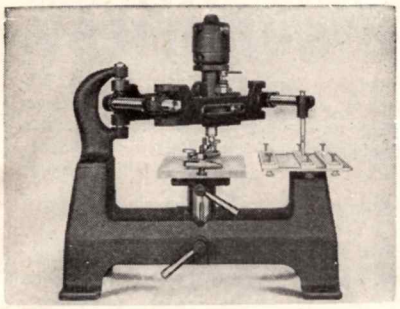

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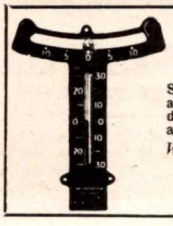

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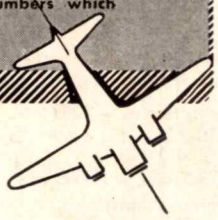

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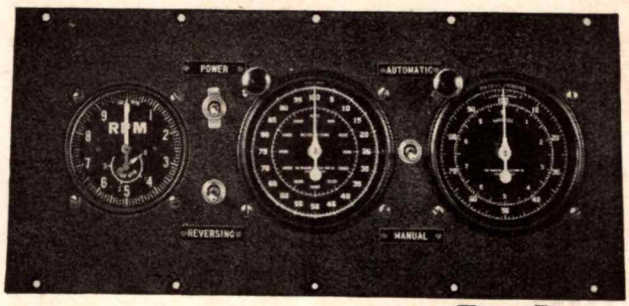

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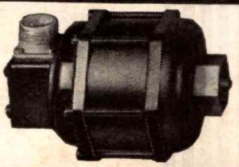

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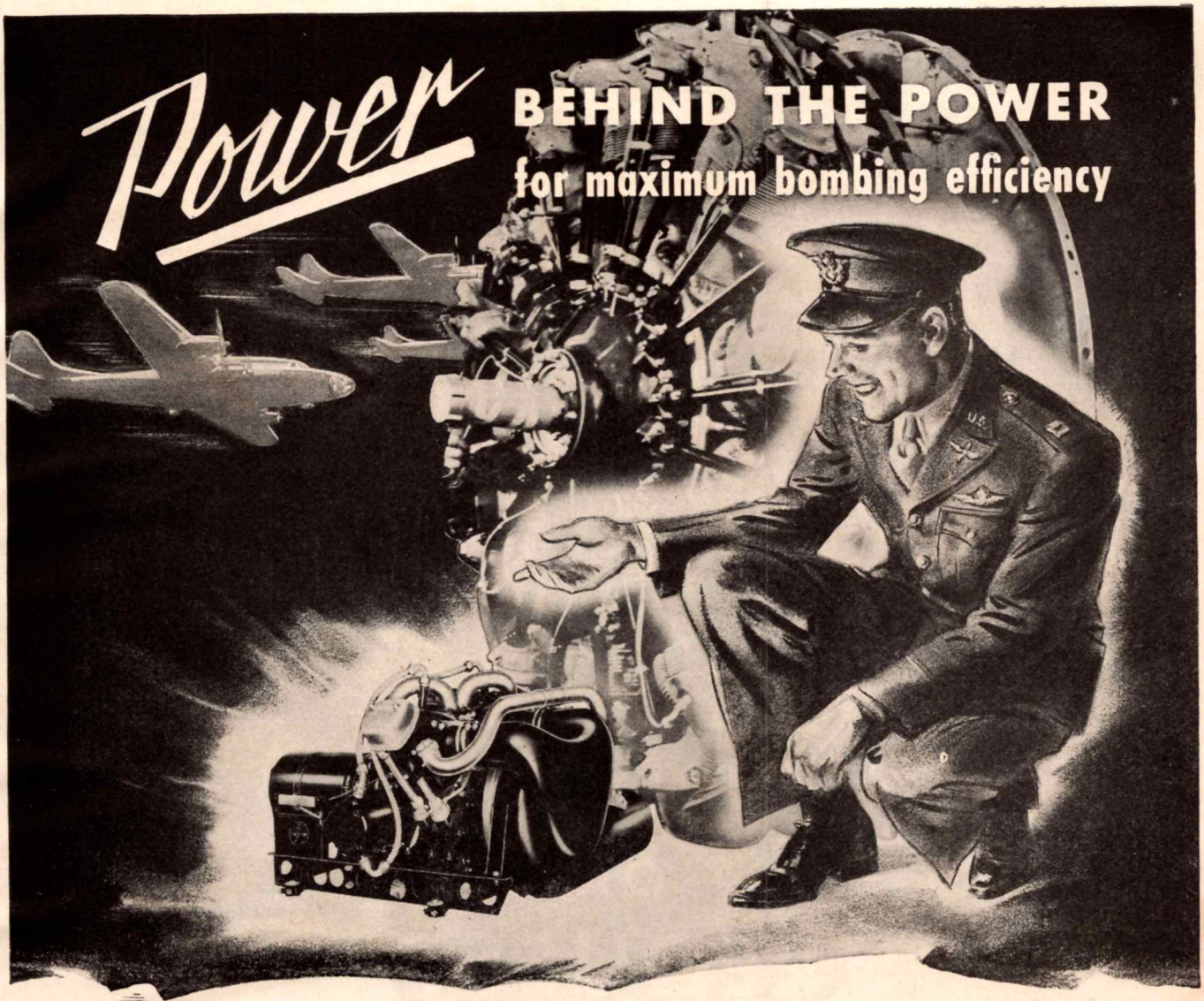
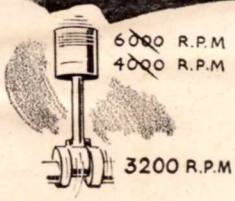
for maximum bombing efficiency





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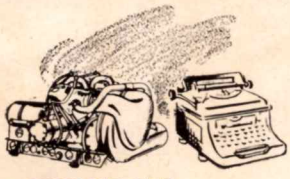

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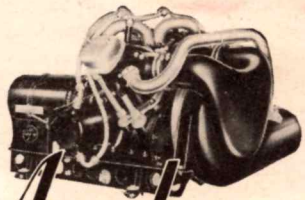

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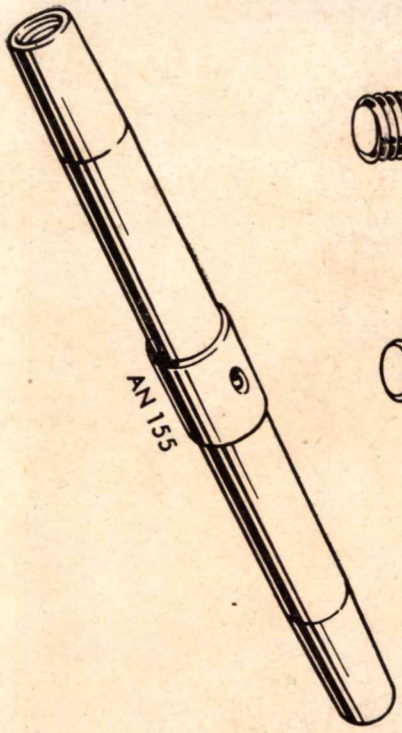

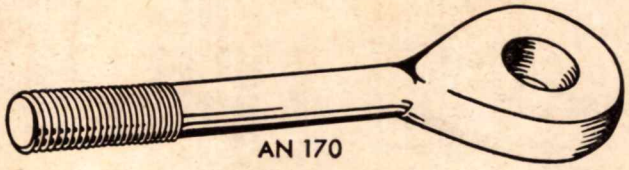

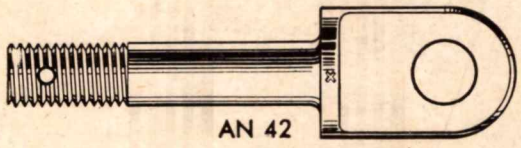

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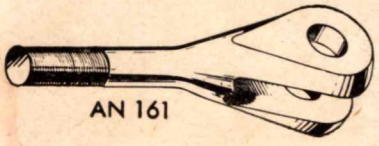

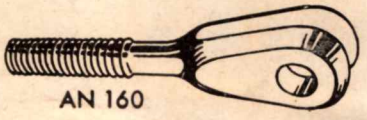

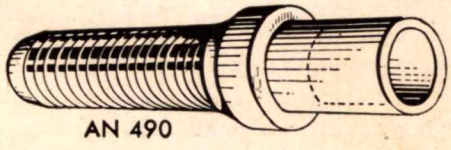

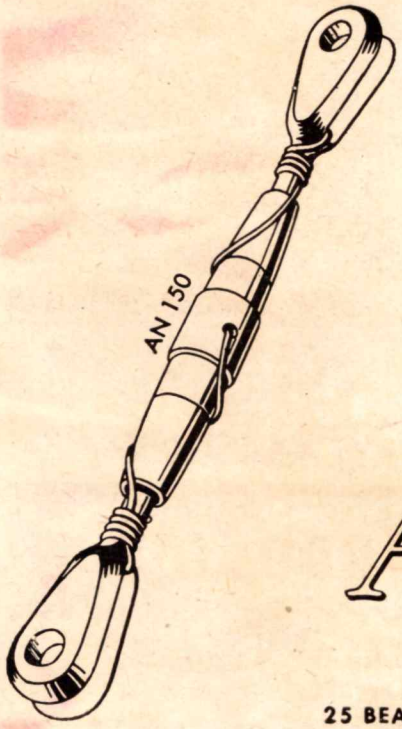

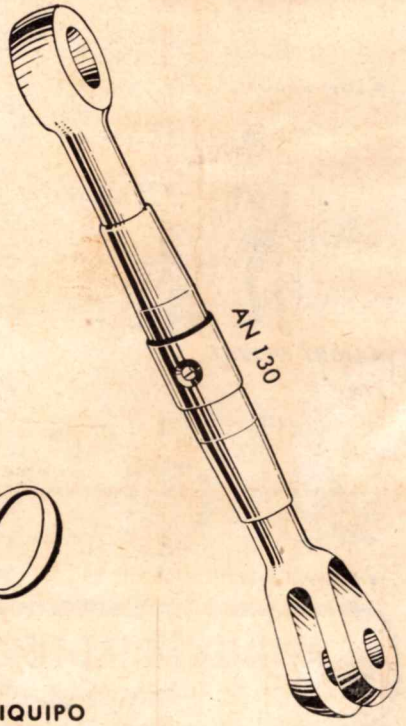

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